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EDITORIAL

HORTICULTURE AGAIN

THERE is an interesting article in the last Annual Report of the Smithsonian Institute by Doctor Casey A. Wood, a naturalist who is not an infrequent visitor to Ceylon. The article is upon the flowers and trees of Kashmir but the author digresses into making comments upon tropical fruit trees and upon some of those found in Ceylon. He recommends to his American fellow-countrymen the great possibilities of such tropical fruit as the cherimoyer and the sapodilla and blames them for the little attention they have given to such fruits. We have frequently called attention in these columns to the great opportunities there are for organised fruit cultivation in Ceylon and the recent news that shipping companies are equipping their boats with small cold storage rooms which can be opened in Colombo to take out shipments of Australian fruit would at the same time afford opportunity for the export of Ceylon tropical fruits. It is very doubtful however if Ceylon is as yet in a position to take any great advantage of these facilities. Possibly the papaw and the mangosteen are produced in quantities sufficient for export but these two are both notoriously difficult of transportation, however, it is not suggested that the difficulty should be considered insurmountable. The horticultural work at Peradeniya has effected a great deal but it has been disappointing in so far that it has not been able to induce the growing of fruit trees on the plantation scale. The enormous number of grafted fruit trees annually distributed

practically all find their way in small numbers into isolated gardens. This is all to the good and deserving of every encouragement. What is required further is the organised planting up of orchards on the acre scale. A few acres under oranges or grape fruit run by an enlightened orchardist with some capital not only could be a commercial success but would also be a tremendous impetus to further planting and it would even enable the promiscuous grower to learn the grading of his fruit, which is the great desideratum, and then to find a market for it perhaps with that of his larger neighbour. The recent necessity to compile accurate statistics of the tea crop in connection with the present Restriction Scheme has demonstrated this beneficial influence of the larger capitalistic grower upon the small-holder, there is far more small-holders' tea in the Island than was ever dreamed of. The small villager with agricultural proclivities is not so altogether loath to adopt new cultivation as is often made out. His economic situation compels him to be certain of his venture and this accounts for his slowness in embarking upon anything new. Born and bred in close association with nature he is pretty shrewd in his way in drawing observations from what he sees around him and when he finds the capitalistic planter growing a crop with success it is a sure incentive to copy him in his own smaller way. It is for this reason that it is greatly to be desired that organised fruit cultivation on the larger scale should be initiated. There are very few attempts at this, at present in the Island. It is not by any means suggested that there are not difficulties to be overcome, there undoubtedly are many. As Dr. Casey Wood points out there is much knowledge to be gained before such an industry can be on the surest footing. One of the wonders of Ceylon is its variety of environment and the suitable environment for any particular fruit must be decided upon with great aforethought. The variety of fruit comes next but there is already at Peradeniya some accumulated experience at disposal to help in this matter as there is also concerning the best stocks for local conditions upon which to put the budwood, for no one with any hope of success with most fruits must consider seedling trees. The proverbial grapes from thorns may perhaps be possible with grafting. There is still a great deal to be learnt about the proper methods of pruning and the proper season for such an operation. It does not do to be too rigidly guided by the methods and seasons followed in other lands,

CONTRIBUTIONS FROM THE COCONUT RESEARCH SCHEME (CEYLON)

STUDIES ON THE COCONUT PALM.—I

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INTRODUCTION

THE need for scientific research on agricultural crops is now well recognised in all civilised countries. Owing to the keen competition that prevails in the world's markets, it is becoming more and more necessary for the producers of raw materials to carry out investigations on three main lines, viz.:

1. To improve the raw materials produced.
2. To devise ways and means of cheapening the cost of production,—in the case of agricultural crops mainly by increasing production.
3. To find new uses for the raw materials.

It is with certain aspects of the two former problems, so far as they concern the coconut industry of this Island, that this paper is concerned.

In this connection and in order to emphasise the necessity for scientific investigation on the coconut palm in this Island it will be interesting to review briefly certain statistical data concerning coconut cultivation.

In Volume II (Coconut Palm Products) of the "Survey of Oil Seeds and Vegetable Oils" published by the Empire Marketing Board in 1932 the following figures are given for the world's acreages under coconuts.

ESTIMATED AREA UNDER COCONUTS IN 1930

British Empire Countries	Acreage (in millions of acres)	Percentage of total acreage
India (excluding certain Indian States)	1.4	20
Ceylon	1·1	15
British Malaya	0·6	8
,, South Sea Islands (excluding Cook Islands and Native reserves in New Guinea)	0·6	8
,, West Indies	0·1	1
British Borneo, Kenya and other British Countries	0·1	1
	3·9	53
Foreign Countries		
Dutch East Indies, ca. ...	1·5	21
Philippine Islands ...	1·4	20
Foreign South Sea Islands, ca. ...	0·3	4
Siam ...	0·1	1
Mozambique, French Indo-China and other Foreign Countries ...	0·1	1
	3·4	47
Grand Total ...	7·3	100

These figures show that in 1930 Ceylon possessed 15 per cent. of the world's acreage under coconuts and came third in the list, India and the Philippine Islands tying for the second place.

In the Census of Production for the years 1924 to 1929 issued by the Statistical Department it is stated that the total area under coconuts in the Island at that time was 1,076,220 acres, of which 162,842 acres were worked as estates over 30 acres in extent and 913,378 acres were in village holdings. Ferguson's Directory for 1929, however, gives somewhat different figures and the total area is given therein as 878,000 acres. This acreage is distributed among the various provinces as follows:

Western Province	...	280,945 acres
Central ,,	...	18,363 ,,
Southern ,,	...	108,468 ,,
Northern ,,	...	46,432 ,,
Eastern ,,	...	21,484 ,,
North-Western ,,	...	348,828 ,,
,, Central ,,	...	4,500 ,,
Uva ,,	...	1,050 ,,
Sabaragamuwa ,,	...	45,431 ,,

Ferguson's Directory for 1930 gives the total area as being a little more than 900,000 acres, of which areas over 5 acres (?) in extent together constitute 268,000 acres. For the year 1933 Ferguson gives the total area under coconuts as 1,000,000 acres of which perhaps 65 per cent. is in small-holdings.

As to the capital invested in coconuts, the not inconsiderable sum of Rs. 500,000,000 has been suggested as an underestimate.

In view of the foregoing facts and also the circumstance that a great many different kinds of fats and oils of both animal and vegetable origin are successfully competing with coconut oil in the world's markets, the bringing of scientific methods to bear on the cultivation of coconuts should be viewed with satisfaction.

II. IMPROVEMENT OF COCONUT PRODUCTS

The main coconut products that are of commercial importance are copra, oil, desiccated coconut and coir fibre. Coir fibre will not be dealt with in this paper, since its importance is only secondary as compared with the products of the kernel. In the three former substances the important constituent is oil, and so improvement in their quality will be concerned mainly with increasing the percentage of oil in the kernel. It is not yet known whether this increase could be brought about by the use of particular manures on established plantations. Even if it could, such improvement will only be confined to that particular generation which has been treated and will not be handed down to the offspring. There is little doubt, however, that from a genetical point of view it is possible to breed coconuts for increased production of oil. This can be done in one of two ways:

1. By keeping the quantity of kernel constant and breeding for high oil content of the kernels.

2. By keeping the oil content of the kernels constant and breeding for high weight of kernels.

The combination of the two methods is also a possibility.

It will be seen, however, that of the two methods, that concerned with the increase of the actual weight of the kernel is the one to be aimed at since the present marketing practice is to sell copra by weight and appearance and not on oil content.

So the problem can be simply stated that the most important aim on the part of those engaged on the genetical study of the coconut palm should be to increase the production of copra of the individual palm.

In breeding for the character of high yield, it is important to discover, if possible, any straight-forward, easily discernible characters of the palm which are associated with it. On examining an ordinary plantation it will be noted that there is great diversity among the palms. Marked differences between palms will be noticed in a great many characters, such as girth of trunk, height, distance between leaf scars, orientation of leaves on the crown, length of leaves, number of leaves produced per annum, number of bunches produced per annum, number of nuts per bunch, size, shape and colour of nuts, and so on.

Differences in girth of trunk are readily noticeable as between palms belonging to different varieties as well as between palms generally included in one single variety. It is well known, for instance, that palms belonging to the San Ramon variety are usually stouter and straighter in the trunk than the members of the local tall varieties, and also that some of the dwarf types have quite slender trunks as compared with the tall forms.

It is perhaps less well known that, as a rule, among local varieties stout, straight trunks are associated with short strong bunch stalks and full crowns.

As regards height, in Ceylon we grow only the tall varieties, but in Malaya the cultivation of the dwarf varieties is also carried out to some extent. In fact the dwarf varieties are often recommended in perference to tall varieties, since it is said that owing to the fact that shortness of trunk is associated with shorter leaves, 90 palms of the dwarf variety could be planted per acre, whereas only 50 to 55 palms of the tall variety can be grown on the same area. Furthermore, it is stated that an acre of dwarf palms is able to produce 20 per cent. more copra than an acre of tall palms.

Distance between leaf scars is another character in which great differences exist as between individual palms. Widely spaced leaf bases are always associated with a long drooping habit of the leaves, and, *vice versa*, closely spaced leaf bases are associated with short, strong, well-oriented leaves.

The number of leaves and consequently the number of bunches produced annually can also vary considerably. A range of 9 bunches per annum to 16 bunches per annum has been observed on Bandirippuwa Estate.

The most noticeable variation, however, is in the number of nuts produced annually by a palm. Jack, working in Malaya, observed as a result of investigations carried on for nine years that the range of variation in this character was from 5 nuts to 115 nuts per palm per annum with a mean value of 59 nuts per palm and a coefficient of variation of 34 per cent. My own observations on 300 palms on Bandirippuwa Estate during two seasons of twelve months each show that for the first season the range of variation of yield was from 1 nut to 105 nuts per palm with a mean value of 54 nuts per palm, and for the second season from 3 nuts to 177 nuts per palm, with a mean value of 69·5 nuts per palm. The coefficient of variability for the first season was 40 per cent., and for the second season 39 per cent. It should be mentioned in passing, that Jack found during the period of his investigations that good yielders remained good and bad yielders continued to be bad.

III. STANDARDS OF SELECTION

Among the many characters in which palms differ from each other, the following have been picked out and studied in detail as being of importance in arriving at standards on which to select mother trees:—

1. Length of Frond.
2. Length of Petiole.
3. Width of Petiole.
4. Length of inflorescence and inflorescence stalk.
5. Number of branchlets on inflorescence.
6. Number of female flowers (button nuts) on inflorescence.
7. Number of ripe nuts.
8. Weight of unhusked nuts.
9. Weight of husked nuts.
10. Weight of copra.

1. LENGTH OF FROND

This character is of much greater importance than is generally imagined. The length of the frond and the character to be considered next, the length of the petiole, are closely connected with the ability of the frond to support the bunch of nuts borne in its axil. The longer the frond, the weaker it seems to be and the

less able to prop up the bunch of nuts. Length of frond is invariably associated with a drooping habit, as a result of which the bunch hangs down, instead of being held up. This is especially noticeable in palms that normally set a large number of nuts. As a result of the increase in weight during the process of ripening, the bunch slips over the frond stalk and hangs down, and quite often the bunch stalk kinks at a point, thereby cutting off the supply of nutrition and water from the ripening nuts. When this happens, the nuts fall prematurely.

On the other hand, short fronds are always better oriented on the crown and provide ample support to the bunches immediately above them. On short fronded palms kinking of bunch stalks is never observed.

On young plantations, when the palms are still short, bunches borne on weak fronded individuals are artificially supported with wooden props, and thus premature nut fall is prevented to a great extent. But on fully-grown plantations the neight of the palms renders such artificial aid impracticable and so nut fall due to this cause cannot be checked.

Measurements carried out on 230 palms show that the length of the fully developed frond may vary from 362 cm. to 620 cm. with a mean value of 475 cm. and a coefficient of variation of 9 per cent.

With such wide variation in length of frond, it will be seen that in the selection of mother trees, other things being equal, only short fronded individuals should be selected.

2. LENGTH OF PETIOLE

The remarks made above concerning the length of frond hold good for the length of petiole also, since, in fact, it is the slightly concave upper side of the petiole towards its proximal end that acts as a rest to the bunch of nuts. The range of variation in length of 230 petioles was from 82·6 cm. to 161·3 cm. with a mean value of 113·2 cm. and a coefficient of variation of 10·7 per cent. It should be mentioned, in parenthesis, that the length of the petiole is a difficult measurement to obtain since there is a distinct flexure at its base near its attachment to the trunk. This flexure renders difficult a linear measurement of the petiole. Therefore, in the tables given below, the length of petiole is really the distance from the basal flexure to the first leaflet.

TABLE I

CORRELATION BETWEEN TOTAL LENGTH OF FROND AND LENGTH OF PETIOLE

Total Length of Frond cm.

Length of Petiole cm.	361—	376—	391—	406—	421—	436—	451—	466—	481—	496—	511—	526—	541—	556—	571—	586—	601—	616—	Tota
81—			1																1
86—				1															1
91—		2	2	4	2	1	1												12
96—	1	1	4	3	3	3	2		1										18
101—				1	6	5	10	5	4	1					1				33
106—				3	2	4	13	8	5	1	1	1							38
111—					3	5	10	13	3	4	2								40
116—				1		2	2	6	10	12	5	2	1						41
121—						1	1	2	3	8	5								20
126—								1	1	4	3	2							11
131—										1	1	2		2					6
136—											1			1		1			3
141—																	1		1
146—																		1	1
151—														1	1				2
156—																	1		1
161—															1				1
Total	1	3	7	13	16	21	39	35	27	31	18	7	1	4	3	1	2	1	230

$\gamma = +0.79 \pm 0.024$

$M_1 = 474.9$ cm. $\qquad M_2 = 113.25$ cm.

$\sigma x = 4.795$ cm $\qquad \sigma y = 12.15$ cm.

$v = 9\%$ $\qquad v = 10.7\%$

TABLE II

CORRELATION BETWEEN LENGTH OF PETIOLE AND WIDTH OF PETIOLE AT A DISTANCE OF 20 CM. FROM THE BASE

Length of Petiole cm.

Width of Petiole 20 cm. from base cm.	87—	91—	95—	99—	103—	107—	111—	115—	119—	123—	127—	131—	135—	139—	143—	147—	151—	155—	159—	163—	167—	171—	175—	179—	183—	Total
9—		1	1																							
10—	3	1	3	3	1	1		2																		2
11—	4	5	11	19	19	9	6	4	2	1	1															14
12—	2	1	10	21	14	23	17	10	12	6	3	4														81
13—	1	—	5	19	23	13	28	23	18	12	6	7	1	1												123
14—	1	1	—	2	6	13	10	18	17	15	13	7	4	1	3	1	1	1								157
15—			1	—	2	—	4	7	10	4	7	5	4	3	4	—	—	—	—	1	1					114
16—								1	3	5	3	3	3	3	—	—	1	1	2	1	1					53
17—								2	—	—	2	2	2	1	—	1	1	1	—	3	2	—	1			27
18—								1	—	—	—	1	1	—	2	1	—	3	3	3	—	—	—	—	1	18
19—														1	1	1	—	—	—	3	2					16
20—															1		1	1	1	—	—	—	1			8
21—																							1			4
Total	11	9	31	64	65	59	65	68	62	43	35	29	15	10	11	4	4	7	6	11	6	—	3	—	1	619

$\gamma = +0.76 \pm 0.02$

$M_1 = 118.7$ cm.
$\sigma x = 17.144$ cm.
$\nu = 14.4\%$

$M_2 = 13.61$ cm.
$\sigma y = 1.97$ cm.
$\nu = 14.5\%$

As would be expected, length of frond and length of petiole are postively correlated. The results given in Table I were obtained from observations made on 230 fully-grown fronds from an equal number of palms.

The correlation in this case is high, being $0{\cdot}79 \pm 0{\cdot}024$. So that in selecting palms for shortness of frond, it may be safely assumed that the petioles on which the bunches actually rest will be correspondingly short.

3. THE WIDTH OF PETIOLE

On a casual study of palms on Bandirippuwa Estate it was thought that the support given to the bunch would be more efficient if with shortness of petiole was combined increased width. Measurements made on 619 palms show, however, that length of petiole is positively correlated with its width and not negatively as was hoped.

These measurements are summarised in Table II, from which it would be seen that the correlation coefficient comes out to $0{\cdot}76 \pm 0{\cdot}017$. The mean width of petiole came out to 13·6 cm. and the coefficient of variation was 14·5 per cent.

Although it would be desirable to combine shortness of petiole with increased width, in practice it will not be easy, even if it were possible by nature, since in the development of the frond all parts seem to be affected in the same manner and in the same direction. Furthermore, it is a matter of observation that this character of width of petiole is of little importance when compared with its length, and in selecting for shortness of petiole the ideal arrived at is achieved, viz. the retention, as far as possible, of as many nuts as are set on the bunch by increasing the mechanical support offered to the bunch.

4. LENGTH OF INFLORESCENCE AND INFLORESCENCE STALK

One of the most desirable characters of a mother palm and one not always observed in selection is the length of the inflorescence stalk. That there is considerable variation in this character is seen in its range, which is from 32·4 cm. to 70·5 cm. with a mean length of 47 cm. and a coefficient of variation of 14 per cent. approximately.

On an average adult plantation it will be readily noticed that the palms display very great diversity with regard to this character. Side by side with individuals possessing very short

inflorescence stalks, so short that the nuts cluster closely in a circle round the crown, may be seen others whose inflorescence stalks are so long that they hang down right over the branches, so that in many instances the bunches rest on the trunk itself. Between these two extremes many intermediate types can be found.

To the practical planter the advantages of short stalks to the bunches are obvious. He knows that bunches borne on long stalks always call for artificial propping. This is especially so in dry districts and during periods of excessive drought. The branches themselves being long, provide no support, and when the bunches hang down the stalks kink almost invariably, as described earlier in this paper. When this happens, the nuts almost always drop at various stages of immaturity depending on the stage of ripeness of the bunch at which the stalk kinked. In exceptional instances the bunch may be torn right off due to its own weight.

With short bunch stalks, on the other hand, this kind of thing never happens.

During our studies it was noticed that there was a definite relation between the length of the inflorescence stalk and the length of the petiole. Measurements made on 234 palms showed that between these two characters there was a positive correlation of $0{\cdot}68 \pm 0{\cdot}04$. A correlation of this sort is of great advantage for purposes of selection, since both shortness of bunch stalk and shortness of petiole, with their attendant strength of tissues and good orientation, are characters of the greatest importance.

The nature of this correlation is best seen on studying Table III given below.

5. NUMBER OF BRANCHLETS ON INFLORESCENCE

The length of inflorescence stalk is positively correlated with the total length of the inflorescence, in this respect resembling, as one would expect, the relation between the total length of the frond and length of petiole. It was, therefore, a matter of doubt whether short inflorescences would contain fewer branchlets, fewer female flowers and fewer nuts than long inflorescences.

Table IV gives the correlation between the two characters, length of inflorescence and number of branchlets. It will be seen from the table that there is a positive correlation, which, however, is weak, being in fact $+ 0{\cdot}35 \pm 0{\cdot}057$.

TABLE III

CORRELATION BETWEEN LENGTH OF PETIOLE AND LENGTH OF BUNCH STALK UP TO BASE OF FIRST BRANCHLET

Length of Petiole cm.

Length of Bunch Stalk up to Base of First Branchlet cm.	82-	85-	88-	91-	94-	97-	100-	103-	106-	109-	112-	115-	118-	121-	124-	127-	130-	133-	136-	139-	142-	145-	148-	151-	154-	157-	160-	Total
32—	1				1	1																						3
34—				2						1																		3
36—				1	4	1	1	2	—	—	3	1																13
38—			1	—	—	5	1	2	1	2	1	—	1															14
40—						2	1	4	3	1	—	1																12
42—				1	2	3	1	6	—	5	9	4	2	2	1													36
44—				1	—	1	3	5	4	5	5	3	3	—	—	2												32
46—							1	4	7	5	6	1	3	1	3	—	1											32
48—							1	2	2	3	1	3	1	4	—	2												19
50—						1	—	1	1	2	3	8	3	2	3	2	1											27
52—								1	—	1	—	3	—	2	1	—	1	—	—	1								10
54—						1	—	—	—	—	1	—	2	2	—	1	1	1	1									10
56—									1	—	—	3	2	1	1	—	—	1	—	—	—	—	—	1	1			11
58—												2	—	1	—	—	—	1										4
60—													1	—	—	—	—	—	—	—	—	—	—	—	1			2
62—																						1						1
64—											1											1						2
66—																		1	1									2
68—																												—
70—																											1	1
Total	1	—	1	5	7	15	9	27	19	25	30	29	18	15	9	7	4	4	2	1	—	2	—	1	2	—	1	234

$\gamma = + 0.68 \pm 0.04$

$M_1 = 113.3$ cm.
$\sigma x = 11.88$,,

$M_2 = 46.96$ cm.
$\sigma y = 6.62$,,
$v = 14.1\ \%$

TABLE IV

CORRELATION BETWEEN TOTAL LENGTH OF INFLORESCENCE AND NUMBER OF BRANCHLETS ON INFLORESCENCE

Length of Inflorescence cm.

Number of Branchlets	53—	57—	61—	65—	69—	73—	77—	81—	85—	89—	93—	97—	101—	105—	Total
22			1												1
24—	1	1	3	2	1			1							9
26—	3	2	4	3	2	1	1	2	1						19
28—	1	1	5	7	10	4	4	3	2	—		1			38
30—	1	3	4	5	10	7	3	6	2	1			1		43
32—	1		2	8	6	9	7	4	1	1	1	1			41
34				9	6	4	6	2	3	—	1				31
36—		2	—	4	4	5	3	1	1	1	2				23
38—			2	2	5	4	3	2	2		2				20
40—					1	2	1								4
42—								1	—	1	1	1			4
44—								1							1
46—							1								1
48—									1						1
Total	7	9	21	40	45	34	29	23	13	4	7	3	—	1	236

$\gamma = +0.35 \pm 0.06$

$M_1 = 73.8$ cm.
$\sigma_x = 9.56$ cm.

$M_2 = 33.2$ cm.
$\sigma_y = 4.42$ cm.

6. NUMBER OF FEMALE FLOWERS

The number of female flowers on the inflorescence is subject to great variation.

On the one hand, inflorescences without a single female flower are met with, and on the other, inflorescences with well over 300 female flowers are by no means rare. Counts made on 215 inflorescences showed a range of variation from 1 to 92 female flowers. A glance at Table V will show that the frequency distribution of female flowers is very asymmetrical and that more than 94 per cent. of the observations lie between the limits 0 and 44.

Table V gives the correlation between number of branchlets on the inflorescence and the number of female flowers borne on them. It will be readily noticed that the two characters are almost non-correlated, the coefficient of correlation being only $+ 0{\cdot}12 \pm 0{\cdot}06$. So that even if in the selection of short inflorescences the number of branchlets is decreased, there is little danger of having the number of female flowers reduced thereby.

7. NUMBER OF RIPE NUTS

Next to the absolute weight of kernel produced per palm, the most important character and indeed the one that is most easily discernible is the number of mature nuts produced.

In ordinary estate practice in this Island, over large areas, the average number of nuts per palm per annum varies from about 20 to 90, this latter figure being uncommon and obtained only on well-cultivated estates in exceptionally good districts. Although these are the estate averages, selected palms within our experience have yielded over a hundred and fifty fair-sized nuts a year, and there are varieties, such as the so-called Bodiri variety, which yield up to 300 small nuts per annum.

Since the number of female flowers on the inflorescence varied within very wide limits, it was thought profitable to ascertain whether the number of ripe nuts was correlated with it.

Table VI gives the relation between these two characters, from which it will be seen that there is a definite positive correlation between them, although not as high as one would expect. For fairly small numbers of female flowers, say below 50, the correlation is fairly close, but for larger numbers of female flowers the numbers of nuts are not always correspondingly high.

TABLE V

CORRELATION BETWEEN NUMBER OF FEMALE FLOWERS AND NUMBER OF BRANCHLETS ON INFLORESCENCE

Number of Female Flowers

No. of Branchlets on Inflorescence	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	Total
22		1																		1
24		3	3	—	—	2	1													9
26	2	2	5	5	2	2														18
28	2	9	5	6	5	4	2	2	1	2						1				39
30		6	13	8	7	1	2	1	2	1			1				2			43
32		3	11	7	6	6	3	—	1	1	1								1	40
34		4	8	4	2	7	4	1	1											31
36	1	2	4	6	2	1	2	3							1	1				23
38		2	5	4	5	—	3	—	—	1										20
40			1	2	—	—	—	1												4
42		1	—	—	1	—	—											1		3
44						1														1
46			1																	1
48				1																1
Total	5	33	56	43	30	24	17	8	5	5	1	—	1	—	1	2	1	1	1	234

$\gamma = + 0.12 \pm 0.06$

$M_1 = 21$ Female Flowers
$\sigma_x = 14.45$ " "
$\nu = 68\%$

$M_2 = 32$ Branchlets approx.
$\sigma_y = 4.37$ " "
$\nu = 13.7\%$

Since the coefficient of correlation in this case is as high as + 0·64, one might be led to conclude that it would be safest to select those palms whose upper immature inflorescences display the largest number of buttons. But in actual practice this would not be so profitable. Palms that carry inflorescences heavily-laden with female flowers are very seldom the best palms from other points of view. In fact, more often than not, they do not come up to the other standards that have been arrived at as criteria for selection. With a certain amount of practice, however, one soon comes to recognise the optimum number of female flowers that should be borne on an inflorescence if it were to set a large number of nuts.

In selecting a palm on the basis of high yield of nuts (full bunches) it is important to make sure at the time of selection that it is not merely the lower bunches that are laden with nuts, but that the upper bunches too are well furnished with fertilised flowers (immature nuts of various sizes). It is also important to make certain that the bunches are evenly set and form a complete ring round the crown without any gaps being left.

The final basis of selection should be on the weight of kernels produced by a palm in a year. It is commonly held that the weight of copra is not positively associated with the number of nuts. This is said to be due to the fact that as the number of nuts per bunch increases, their size diminishes and so the resultant amount of copra produced by them does not increase, but might in fact be less than that produced by a moderate number of nuts.

If it is assumed that the size of nut is positively correlated with its weight, a study of Table VII will show that for normal estate populations of tall palms there is only a mere tendency towards a negative correlation between number of nuts and size of nut (or weight of nut, or, as will be seen later, weight of copra produced). The correlation coefficient is – 0·25 with a standard error of 0·06.

It will be seen, therefore, that the generally accepted relation between numbers of nuts and size of nut is not so close. In a mixed population of tall palms it may be safely assumed that the slight decrease, if any, in the size of nut is amply compensated for by the increase in the number of nuts.

TABLE VI

CORRELATION BETWEEN NUMBER OF FEMALE FLOWERS ON INFLORESCENCE AND NUMBER OF NUTS

No. of Female Flowers

No. of Nuts	0—	4—	8—	12—	16—	20—	24—	28—	32—	36—	40—	44—	48—	52—	60—	72—	76—	80—	84—	92—	116—	Total
0		1																				
1	2	1	2	—	—	2																1
2	1	3	3	2	—	2	1	—	1	1												7
3	2	2	2	1	1	2	—	2	—	—	1											14
4		3	7	6	1	2	—	1											1			14
5		4	7	9	3	2	1	1						1		1		1				20
6		4	1	8	3	3	3	2	2	—	2				1							30
7		1	6	7	5	2	1	4	3	1												29
8			5	7	6	3	5	1	—	1	—	3			1					1		31
9				2	4	2	3	1	—	1							1					32
10			1	4	6	3	3	1					1									14
11				2	2	1	1	—	3													19
12				1				1	1	1												9
13						1	1					1										4
14						2															1	4
15							1				1						1					3
17							1															2
19										1												1
25								1														1
																						1
Total	5	19	34	49	31	27	21	15	10	6	4	4	1	1	2	1	2	1	1	1	1	236

$\gamma = +0.64 \pm 0.038$

$M_1 = 20.92$ Female Flowers $\qquad M_2 = 6.8$ nuts

$\sigma x = 11.91$,, ,, $\qquad \sigma y = 3.37$,,

TABLE VII

CORRELATION BETWEEN NUMBER OF NUTS AND WEIGHT PER HUSKED NUT

Number of Nuts

Weight per Husked Nut — decagrammes	3—	6—	9—	12—	15—	18—	21—	24—	27—	30—	33—	36—	39—	42—	45—	Total
35—						1										1
40—		1	—	—	1	1										3
45—				1	1	1	1	1								5
50—	1	—	—	1	2	1	3	1	—	3						12
55—	1	—	1	—	1	3	—	2	3	1	—	1				13
60—	3	1	3	6	4	2	2	2	2	1	—	2				28
65—		2	6	2	5	4	7	3	—	1	—	—	1	—	1	32
70—		1	3	7	3	6	5	4	5	—	1	—	2			35
75—	2	—	5	7	9	5	5	3	1	—	2	—	1			40
80—		1	3	5	4	5	2	3	1	1	—	—	1			26
85—	1	3	3	7	3	3	2									22
90—	2	1	—	4	2	3	1	1	1							15
95—		1	4	3	4	—	1									13
100—	1	3	3	—	1	1	—	1								10
105—			1													1
110—			3	—	1	2										6
Total	11	14	35	43	41	38	29	19	13	7	3	3	5	—	1	262

$\gamma = -0.25 \pm 0.06$

$M_1 = 18$ Nuts $\qquad M_2 = 75.8$ Decagrammes

$\sigma x = 7.87$ Nuts $\qquad \sigma y = 14.88$,,

As stated already, there are certain types of palms which bear very small nuts in large numbers, a single bunch carrying as many as 70 nuts in some cases. It has not been found possible yet to study these types in detail, so that it may not be stated at this stage of our investigations whether the absolute weight of kernels produced by them is higher than that produced by the common forms which produce smaller numbers of medium and large sized nuts.

In order to arrive at some idea regarding the relation between weight of copra and number of nuts per palm in a mixed population, the nuts from a single pick from 263 palms were turned into copra separately and weighed. The results obtained are given in Table VIII.

It will be easily observed that contrary to general ideas, the correlation that holds between number of nuts and weight of copra for individual palms is very high, the coefficient of correlation being + 0·91. There is, therefore, little danger in using the number of nuts produced as one standard in the business of selecting desirable trees.

8. THE WEIGHT OF NUTS UNHUSKED AND HUSKED

In order to bring in a further refinement to our methods, it was thought that a basis of selection even more reliable than the number of nuts produced annually would be the weight of nuts in the husks and better still the weight of husked nuts.

In Ceylon it is the normal practice on estates to leave the picked nuts in a heap on the field for a period of three weeks or a month, presumably for the purpose of attaining full maturity. During this period the husk loses its green colour, becoming dark-brown, and also dries out to a certain extent.

Accordingly, the nuts from the 263 trees aforementioned were left on the field for one month and at the end of that time they were weighed in the husk. They were then husked and the husked nuts were weighed. The nuts from the different palms were then cured separately in wire-netting bags—the same number of firings being given to every sample—and the copra weights were obtained. The results are given in the form of correlation Tables IX and X. Table IX gives the correlation between the weight of unhusked nuts per palm and weight of copra produced from these nuts. The correlation is very close, the coefficient being 0·91.

TABLE VIII

CORRELATION BETWEEN NUMBER OF NUTS AND WEIGHT OF COPRA

No. of Nuts

Weight of Copra Kg.	3—	5—	7—	9—	11—	13—	15—	17—	19—	21—	23—	25—	27—	29—	31—	33—	35—	37—	39—	45—	Total
0.5—	2	2																			4
1—	3	7	3	1	—	1															15
1.5—		1	3	7	3																14
2—		1	2	4	10	3	2	1													23
2.5—			1	6	7	7	3	2	1	1											28
3—				2	6	8	4	4	2												26
3.5—					6	2	11	1	2	1	1										24
4—						6	6	13	4	3	1	1	1								35
4.5—							3	2	11	4	3	1									24
5—							1	1	2	4	4	3	—	1							16
5.5—								1	2	2	5	3	2	3	1						19
6—										1	1	2	1	2	1						8
6.5—									1	1	3	—	3	1							9
7—											1	1	—	2	1	—	2				7
7.5—													1	—	—	1	—	1			3
8—																2	—	—	1		3
8.5—																			1	1	2
9—																			1		1
9.5—																			1		1
10.5—																			1		1
Total	5	11	9	20	32	27	30	25	25	17	19	11	8	9	3	3	2	1	5	1	263

$$\gamma = + 0.91 \pm 0.01$$

$M_1 = 17.98$ nuts $\qquad M_2 = 4.05$ kg

$\sigma x = 7.78$ „ $\qquad \sigma y = 1.84$ kg

Table X gives the correlation between weight of husked nuts and weight of copra. Here the correlation is remarkably high, the coefficient being $0{\cdot}96 \pm 0{\cdot}005$.

The results given in the last three tables are of great value, since they afford a short cut in effecting a selection for high yield. They will also be of value to those engaged in manurial experiments, since it will not be necessary to convert the nuts from various blocks into copra in order to arrive at the relative merits of various manurial treatments.

High yield must ultimately mean high weight of kernel. But it is evident that the practical business of curing the nuts from individual palms at each pick for a number of years will be impossibly tedious and always open to error both from carelessness of handling and unequal drying. Therefore, it is matter for satisfaction that the three characters, number of nuts, weight of unhusked nuts, and weight of husked nuts, are all positively correlated to a high degree with the weight of copra.

Of the three characters, weight of husked nuts is the most reliable, since it displays the highest degree of correlation with the weight of copra. It is a safer standard than the number of nuts, since in this case a weight is more reliable than a count, and it has an advantage over the weight of the unhusked nut in that the weight of the husk might vary a good deal according to the humidity of the atmosphere and might take up large quantities of water during rainy weather. The shell is, on the other hand, well protected from the outside world and owing to the nature of its texture is much less liable to be influenced by changes in the degree of humidity of the atmosphere.

IV. CONCLUSION

It is now possible to lay down certain definite standards which must be borne in mind in the selection of mother trees. A desirable mother tree could be described as having the following points:

1. A short straight trunk of even girth.
2. Short fronds, well-oriented on the crown.
3. Short bunch stalks.
4. A fair number of female flowers on the inflorescences.
5. A large number of inflorescences, carried evenly round the crown.

TABLE IX

CORRELATION BETWEEN WEIGHT OF UNHUSKED NUTS AND WEIGHT OF COPRA

Weight of Unhusked Nuts

Weight of Copra Kg.	2.5—	5—	7.5—	10—	12.5	15—	17.5—	20—	22.5—	25—	27.5—	30—	32.5—	35—	37.5—	40—	42.5—	45—	47.5—	55—	60	Total
0.5—	1	3																				4
1—		4	6	2	1	1	1															15
1.5—			1	2	8	1	2															14
2—				2	9	4	5	1	1													22
2.5				1	2	8	5	10	3													29
3—					1	4	7	8	3	2	—	1										26
3'5						2	4	8	7	—	3											24
4—							1	5	8	11	5	3	1	—	2							36
4.5								2	3	6	6	2	3	—	1							23
5—										1	4	4	2	4	—	—	1					16
5.5—										3	3	6	4	2	1							19
6—												2	1	4	1							8
6.5—												3	4	2								9
7—													2	—	3	1	—	—	1			7
7.5—																2	1					3
8—																		1	2			3
8.5—																				1	1	2
9—																				1		1
9.5—																	1					1
10.5—																				1		1
Total	1	7	7	7	21	20	25	34	25	23	21	21	17	12	8	3	3	1	3	3	1	263

$$\gamma = +0.91 \pm 0.01$$

$M_1 = 24.51$ kg. $\qquad M_2 = 4.04$ kg.

$\sigma_x = 9.832$ kg. $\qquad \sigma_y = 1.835$ kg.

$\nu = 40.1\ \%$ $\qquad \nu = 45.6\ \%$

TABLE X

CORRELATION BETWEEN WEIGHT OF HUSKED NUTS AND WEIGHT OF COPRA

Weight of Husked Nuts Kg.

Weight of Copra Kg.	1.5	3	4.5	6	7.5	9	10.5	12	13.5	15	16.5	18	19.5	21	22.5	24	25.5	27	30	33	Total
0.5	1																				4
1	1	7	3	3	1																15
1.5			3	8	3																14
2				10	6	5	1														22
2.5				3	9	12	5														29
3					2	11	9	2	1												26
3.5				1	—	1	7	11	9	5	1										34
4						3	12	9	10	9	2	—	1								35
4.5								2	3	5	5	1	2								24
5										4	9	5	—	—	1						16
5.5										1	—	2	3								10
6												2	3	4							8
6.5													1	1	2	2					9
7															1	2					7
7.5																1	2				3
8																	3				3
8.5																		2			2
9																		1			1
9.5																		1			1
10.5																				1	1
Total	5	7	6	25	41	33	34	24	23	24	17	10	11	5	4	5	3	2	2	1	261

$r = +0.96 \pm 0.005$

$M_x = 12.93$ kg.
$\sigma_x = 5.62$ kg.
$v = 43.5\ \%$

$M_y = 4.04$ kg.
$\sigma_y = 1.835$ kg.
$v = 45.6\ \%$

6. A large number of nuts. the size of nut being of no importance as long as the number is large. The selection of varieties bearing very small nuts in large numbers cannot be recommended without further investigation.

7. High weight of husked nuts.

As regards the age at which a palm is best suited for the production of seed, there is no direct evidence; and the circumstantial evidence is somewhat conflicting. It is generally stated that immature palms before reaching maximum production capacity are unsuitable as seed bearers; and also that palms older than 50 years should not be selected for seed purposes. In both instances it is stated that the offspring of such palms would be weaklings and poor producers. These ideas are not based on direct observation, but are apparently connected with some analogy drawn from the reproductive performances of higher animals and the conditions of the offspring as related to the age of the parents. The prime of life of the coconut palm is variously fixed between 20 and 50 years, apparently on the same analogy. Scientific evidence on this matter is not available, and therefore it may be just as well to follow traditional methods until such evidence is forthcoming.

V. SUMMARY

1. In the introduction there is a brief discussion on the need for improvement of the coconut palm from the point of view of yield.

2. Mention is made of the great variation of characters of the coconut palm, and an attempt is made to discover any relations that may exist between such characters and yield.

3. Ten correlation tables are given in explanation of such relations.

4. A brief enumeration is made of the points of a good mother palm.

REFERENCES

1. Jack, (H.W.) & Sands, (W.N.)—The Dwarf Coconut in Malaya. Malayan Agric. Journ. X. Jan.—Dec. 1922, pp. 4-12.
2. Jack, (H.W.)—Variation in Coconuts with Particular Reference to Fruit Production. *ibid.* XIII, No. 2, February, 1925.
3. Jack, (H.W.) & Sands, (W.N.)—Variation in Coconuts. *ibid.* XV, No. 11, Nov. 1927, pp. 387-399.
4. Jack, (H.W.)—Improvement of the Coconut Crop by Selection. *ibid.* XVIII, January, 1930, No. 1, pp. 30-39.
5. Furtado, (C.X.)—A study of the Coconut Flower and its Relation to Fruit Production. Gardens Bulletin, III, 1923-25, pp. 261-274.
6. Marechal, (H.)—Observations and Preliminary Experiments on the Coconut Palm with a View to Developing Improved Seed Nuts for Fiji.—Agricultural Journal of Fiji, Vol. I, 1928, No. 2, pp. 16-45.
7. Ferguson's Ceylon Directory, 1930-1933.

NOTES ON ORCHIDS CULTIVATED IN CEYLON

SPATHOGLOTTIS AUREA VIEILLARDI (GARDEN VARIETY)

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SPATHOGLOTTIS is a genus of orchids indigenous to certain warm regions of the world such as Malaya, Burma, Tropical Australia, New Caledonia and New Guinea. Orchids of the genus, as a rule, have beautiful flowers and therefore are often seen in Ceylon decorating the house verandah or out in the open enhancing the colour effects of the garden.

All species of Spathoglottis (popularly known as "Ground Orchids") are terrestrial and have a marked similarity to one another in their habits of growth. They are easy to grow.

This Spathoglottis is a garden hybrid of *S. aurea* Lindl. X *S. Vieillardi* Rchb. and is sometimes designated *S x Veitchii*. As it flowers abundantly it provides a very graceful decorative plant which is tended carefully in many homes today. The corm-like pseudo-bulbs are more or less globose or globosely conical: the leaves are dark shiny green and lanceolate, two to four inches broad, which narrow at the base into an elongated petiole.

The fleshy yellow flowers are borne on a long spike often four to five feet in height, the raceme looking very like a simple umbel. The individual flower is about two inches across; the petals and sepals are speckled with crimson, the former slightly broader and the lip shorter than in the sepals. The under side of the flower is also richly speckled with the same hue. The flowers are developed together and as they fade the rachis elongates and continues to bear new blooms for several weeks.

All species of the genus are easy to manage and bloom practically all the year round. It is no wonder that they have become both the popular decorative plant of the verandah and the favourite of the florist for cut flowers.

Spathoglottis aurea Vieillardi

Culture.—All members of the genus Spathoglottis and its many hybrids now acclimatised in Ceylon, (*S. plicata*, *S. Vieillardi* *S. plicata* var. *alba*, *S. kewensis* and our subject) need periodical re-potting if good heads of flowers are desired, although even uncared-for plants regularly produce blooms: these make a poor comparison however with those under proper cultivation.

Owing to its free flowering and the consequent drain on the plant an occasional top-dressing with rich porous soil acts as a great stimulus to the plant. A word of warning here will not be out of place with regard to this operation—never charge the pot with cowdung when top-dressing. A little decomposed cattle manure mixed with sand is all that is necessary. But the best mixture for both top-dressing and potting is made thus: mix one part of leafy soil, one part of turfy soil, two parts of well-decomposed cattle manure and one part of coarse sand together, finishing off with a surface dressing of charcoal and brick pieces. This top layer is of value, in allowing free access of air and keeping the compost warm and sweet, while also preventing soil wash when watered and during rainy weather.

Propagation can be effected either by sowing seed or dividing the pseudo-bulbs. If the latter method is employed the dormant pseudo-bulbs should be planted in separate pots to increase the stock while the young pseudo-bulbs with new growth are transferred into pots for pot culture. Cut off all dead leaves and roots with a knife, reduce the live roots to half their length and then insert the bulbs in the compost. It is not absolutely necessary to use perforated pots; but if special pots with perforations at the sides are available the plants will thrive better. The pots should be thoroughly washed and dried before use. Unclean and mossy pots are not only untidy in appearance but also arrest free aeration and retard growth. A thick layer of drainage material, such as crocks, over which a few dried leaves are placed, may be used to prevent clogging. The plants should be placed with roots completely buried and the pseudo-bulbs about half-an-inch below the rim of the pot. This allowance is to provide space for the dressing with charcoal and brick pieces.

The newly-potted plants will need stakes at least for some time to prevent them from being unduly disturbed by wind. All newly-potted plants should be placed in a shady spot until bush growth appears, after which they may be removed to the open.

The majority of species of Spathoglottis thrive in the open with plenty of sun, but at the same time they require liberal supplies of water applied late in the afternoon.

If, however, propagation by seed is desired, seed capsules should be removed at the first sign of cracking when they will be quite soft to the touch. The capsules should be placed in a paper envelope for three or four days. During this time they will discharge the seed which must be carefully spread on a compost of broken bricks, coconut husk, wood and charcoal. No syringe or watering-can can be used as they will wash away or bury the seed too deeply in the compost. A fine spray may be employed four to five feet above the seed pan.

KASHMIR PLANTS*

SPEAKING of "introduced" species of plants and animals, it is by no means easy to say how long flora and fauna must live and propagate their kind in a new land before they can claim a place among the citizens of the country into which they come as migrants. It is a matter of opinion. For example, among the Indian flowering trees are the *Browneas* (already mentioned) that dispute the title with *Amherstia* as the most beautiful blossoming trees in the world, yet the members of the former genus were originally South American. The most attractive of them all and the one that I know best is *B. grandiceps*, the rose of Venezuela, that reaches a height of 40 feet. When in full bloom this tree is one blaze of glory from branches of bright red flowers borne in large, dense heads at the extremities of the branches. As in the case of *Amherstia*, the foliage is also very conspicuous. The young mottled leaves are grown as long flaccid bunches, giving the tree the appearance of bearing two dissimilar sets of flowers.

One of the most striking and showy of eastern silva is the so-called pride of India or queen's flower (*Lagerstroemia flos-reginae*), named after the East Indian botanist Magnus van Lagerstroem. It is found all over India, Ceylon, and Malaya and from April to October bears from the ends of its branches erect panicles of lovely bright pink or mauve blooms. With the exception of a short time during the rainless season these beautiful trees retain their green foliage. The margin of the pretty Kandy Lake in Ceylon is brightened by many flowering trees, but none more attractive than this magnificent species.

I have always been intrigued by a flowering tree whose acquaintance I first made in India, the *Bauhinia purpurea*, a species of that interesting genus whose name is derived from the related facts that its leaves are joined in twos at the base and that there lived and worked in the seventeenth century two Swiss brothers, scientific twins, members of a family celebrated as physicians and botanists. How appropriate that Caspar and Jean Bauhin should sponsor this interesting tree, now an adornment of many gardens all over the world. In addition to *B. purpurea*, probably the most widespread and best known of the genus, with its large, showy, orchidlike pink flowers merging into purple, we have *B. triandra* or mountain ebony, closely resembling *purpurea*; *B. tomentosa* with yellow flowers; *B. krugii*, native of Puerto Rico; and many others whose fruit is a long, flat, beanlike pod.

Planted and encouraged to grow near Buddhist temples is often found another of my favourites, the Naka or Ceylon ironwood (*Mesua ferrea*). It prefers the hot and moist areas of British India, where during April and May this moderate-sized, conical and handsome tree profusely

* Extracted from "Through Forest and Jungle in Kashmir and other Parts of North India" by Dr. Casey A. Wood in the Annual Report of the Board of Regents of The Smithsonian Institution for 1932.

blossoms as large, scented, white flowers with a yellow centre of numerous stamens. New, deep crimson leaves appear twice a year, greatly adding to the beauty of an attractive species.

In the drier regions of India (one sees avenues of it on the road to Mount Abu) grows an erect 40-foot tree with large broad, tri-foliate leaves, the "flame of the forest" (*Buteo frondosa*). During the dusty, rainless months when nature calls for some attractive living thing to cheer the passer-by this remarkable tree puts forth a profusion of beautiful crimson or orange-scarlet flowers whose flaming blooms justify its English vernacular name. It has, of course, many native titles, among them the dhak, mentioned by Kipling as a meteorological forecaster. When the tree blooms early and soon withers, the dry season will be prolonged and disastrous. The tree also produces a useful resin called *kino*, and a valuable fibre. The young branches are a source of lacquer and the flowers are used in India for making orange and yellow dyes.

This partial catalogue of beautiful trees of north India would be incomplete without speaking of what is generally regarded as the most lovely of all the blossoming silva one meets with in the Far East. I refer to an originally Burmese tree, the *Amherstia nobilis*, named after Lady Amherst, the wife of a former British governor of Burma. H. F. Macmillan's description (Tropical Gardening, pp. 82, 83) of this silvan beauty as found in Ceylon gives a fine picture of the charming species, that combines in a wonderful way ornamental foliage with showy blossoms. The leaves, accompanied by large graceful sprays of vermilion and yellow flowers, drooping from every branch and interspersed with the handsome foliage, present an appearance of astonishing elegance and loveliness. It is in blossom for the greater part of the year, except during long periods of rainy weather, the chief flowering season in Ceylon being from November to April. The tree grows to a height of 50 to 60 feet, is usually round-topped, with many slender branches and dark-green pinnate leaves. A remarkable feature is the long, hanging, brownish-pink clusters in which the young leaves appear. This habit is also characteristic to some extent, of certain other tropical trees as *Brownea grandiceps* and *Saraca indea* and *declinata*. In the latter case the young leaves are mottled pale-gray or almost white.

The tree thrives in the moist low-country up to 1,600 feet, and requires deep, rich, and well-drained soil. It does not seem to flourish near the sea, and is rarely met with about Colombo. It produces seed very scantily anywhere, a pod or two (which are flat, brown, 6 to 8 inches long, containing one to three large flat seeds) occasionally being all that can be obtained.

The genus *Cassia* furnishes many a beautiful, flowery tree species more or less widely spread over India, to the delight of the visitor. It is impossible here to do more than describe (briefly and inadequately) a few of the more attractive varieties.

The most interesting is, perhaps, *Cassia fistula*, the Indian laburnum, but also known by several other English and native vernacular synonyms. This is a rather small, upright tree and one of the most beautiful objects in the north Indian forests, where it prefers a dry or well-drained soil,

When in full bloom, it suggests its common name, bearing masses of yellow flowers in pendant racemes. The blooms are, with the frangipani, much used as temple offerings while the astringent bark is used in medicine and for tanning. Another remarkable character of this laburnumlike shrub is its fruit-black, cylindrical pods that grow to a length of 20 or 30 inches, the pulp of which is a well-known laxative.

Although originally a native of South America, *Cassia grandis*, or the horse cassia, is found in north India. It is a spreading tree that attains a height of 40 to 50 feet, bears a profusion of pale pink flowers during the dry months, February and March (when it is completely deciduous), and in June produces numerous thick, coarse-skinned curved pods with an offensive odor.

A more attractive example of cassias is *C. multijuga*—a slender, quick-growing tree—indigenous to South America. It is in full bloom during August and September and is practically smothered with immense branches of bright yellow flowers, suggesting, as Macmillan says, a glorified tree calceolaria. It grows everywhere fairly well, but prefers a dry soil and climate.

Finally, during May and June a moderately sized, deciduous pink cassia (*Cassia nodosa*, so named because of its knotted stems) bears in great profusion lovely, bright-pink, rose-scented flower sprays. It is a native of Bengal and, like all the cassias, produces large pods—cylinders 12 to 15 inches long.

Trees that take kindly to all tropical and semi-tropical countries and to some temperate areas are several species of *Jacaranda*. I have seen many examples in both the New and Old World, including India, Ceylon, and California, although these trees are originally South American.

J. mimosafolia is a very beautiful species not only on account of its profusion of purplish-blue, bell-shaped flowers, but because of its elegant, mimosalike, bipinnate leaves. When the blooms are shed they form a thick blue carpet that characterizes this charming tree.

One of the most beautiful flowering trees of India (and of other tropical countries) is the iyavaki (*Peltophorum ferrugineum*), a large symmetrical tree of quick growth, indigenous to Malaya and Ceylon. It has a spreading top and fine feathery foliage. It blossoms irregularly twice a year, flowers and fruit often appearing at the same time. Its flowers, large, erect panicles, are scented and brownish yellow, and the tree when in full bloom presents a magnificent spectacle.

Of special interest to the traveller in India is the widespread appearance of the tree (or shrub) frangipani or pagoda tree (*Plumeria acutifolia*), a large, low, spreading shrub, quite bare of leaves, introduced from America. It is a familiar tree in almost every tropical country. In the Far East it is a well-known "temple tree," its strongly scented heads of white, yellow-centered flowers being a common offering at Buddhist altars. A scarlet variety (*P. rubra*) is very showy and remains in full bloom for several months.

A wonderful, beautiful and highly ornamental tree has spread by introduction into most tropical and semi-tropical countries. This is the famous *Flamboyante*, flame tree or golden mohur (of India). It originated in

Madagascar and is now familiar to travellers because of its truly gorgeous flowers. It usually blooms in April and May, grows to a height of 40 to 50 feet, and with its spreading habit is well calculated to show a flaming top and handsome, long, feathery, bipinnate leaves. In many countries (British Guiana, Tahiti, India) I have seen avenues of these flame-colored tree tops whose glory must be seen to be fully appreciated. It is best known in America as the Royal Poinciana.

An Indian tree that originally came from West Africa is especially conspicuous from a distance because of its tallness and erect growth. This is the so-called tulip tree (*Spathodea campanulata*). I have noticed most of these in and about Kandy, Ceylon, where they serve the double purpose of shade and ornament. The large, erect, bright scarlet-orange flowers that crown the topmost branches of this handsome species make it a conspicuous object in even the distant landscape. The unexpanded flowers always hold considerable water that, scattered by a passing breeze, may be unexpectedly showered on the pedestrian beneath. This circumstance has given it one of its common names, the fountain tree.

Stenocarpus sinuatus, the Queensland fire tree, has taken kindly to north India, where it is occasionally seen. It is an erect tree 40 to 50 feet high, whose peculiar and very showy clusters of scarlet flowers are noticeable objects wherever they grow. It flowers from May to July at elevations from 1,500 to 4,000 feet.

Another important Australian species is the flame tree (*Sterculia acerifolia*), of medium size, a species with large, glossy, angular leaves, preferring high altitudes, at least up to 5,500 feet. It blooms in May and June when bare of leaves, producing brilliant masses of bright red blossoms.

Tropical fruit trees little known in America.—As every observing traveller in the Near and Far East knows, only a few edible tropical fruits have been widely grown and improved by scientific cultivation in American and other temperate climates. And yet there is no reason why many others should not be domesticated in the United States. As Macmillan has pointed out, certain tropical fruits, unsurpassed for their lusciousness and food value, are still capable of considerable improvement and of adaptation to a change of environment by "selective or asexual propagation, by budding, grafting, layering, cuttings, etc., or by hybridization and high cultivation."

These problems have long been considered by our highly competent and active Department of Agriculture, and it seems a wonder that some of the most obviously valuable of the long list of desirable tropical and semi-tropical trees are not more extensively utilized by American fruit growers in such localities as are suitable for their profitable adoption. One of the errors to be avoided in this connection is a slavish imitation of fruit-growing methods in the Tropics themselves, where as a rule the lines of least resistance are followed; for example, the lazy methods of seed propagation instead of more laborious though generally more profitable schemes involving careful selection of stock and its budding, grafting, fertilizing, regular pruning, and replanting. There is, of course, room to speak of only a few of these attractive and desirable fruits but little known in North America.

The sapodilla plum (*Achras sapota*)—in India sometimes improperly called mangosteen—or noseberry is a medium-sized (20 to 30 foot) tree with shiny, dark green leathery leaves, originally from tropical America but cultivated throughout India. An enthusiastic naturalist says of this russet apple-like fruit (made up when ripe of a mass of soft, brownish pulp holding a number of easily separated large black seeds), "a more luscious, cool, and agreeable fruit is not to be met with in any country in the world." The sapodilla thrives up to 3,000 feet and usually bears two crops a year.

The papaya, pawpaw, or tree-melon (*Carica papaya*) is a small, fast-growing, branchless, herbaceous tree, from 15 to 20 feet high, widely cultivated throughout India. It bears a crown of long and large palmate leaves at whose base the delicious, juicy "melons" are produced. These green-coloured fruits are ovoid or round, 8 to 14 inches in length and 4 to 6 inches in diameter, and weigh from 5 to 10 pounds. One of the remarkable virtues of the tropical pawpaw is that it is in season the year round. Macmillan says of it:

The fruit has a central cavity, to the walls of which the olive-coloured seeds are attached, unusually in great abundance, but sometimes entirely absent. The succulent flesh is of the pinkish or orange tint, very refreshing and agreeable to the taste, especially on first acquaintance. It is generally estimated as a table fruit, and is considered an aid to digestion. Some people prefer to eat it with a little sugar and fresh lemon or lime juice. It may also be made into jam or sauce, and in the unripe state may be pickled, or boiled and used as a vegetable. The seeds have a flavor like that of water cress. Papaine, a digestive enzyme, valued in medicine and in the preparation of chewing gum, etc., is obtained from the white, thin latex or juice.

The mangosteen (*Garcinia mangostana*) originated in the Malay States, but is now generally cultivated in India and Ceylon. This is one of the most delicate fruits of the Tropics and I enthusiastically endorse the claim that it partakes of the combined flavor of the strawberry and the grape. The tree is of small size and slow growth; the leaves large and leathery. The globular, purple-brown, smooth fruit looks like a small apple whose white, melting pulp surrounds several large seeds, the whole contained in a thick, inedible covering. This fruit is rather expensive, is regarded as a great delicacy, and is generally in season from May to July. Its cultivation (usually by seed) ought to be attempted as a delicious novelty in semi-tropical America.

The sugar-apple or sweet-sop (*Anona squamosa*) deserves mention as a candidate for a domestic adoption in the warmer climate of North America. It originated in South America, where it is extensively cultivated, although little known north of the Mexican border. The tree, a small species, thrives in any ordinary, well-drained soil up to 3,500 feet

and its fruit, maturing twice a year, generally in October and April, is the size and shape of a large apple whose yellowish-white, scaly or tubercular rind incloses a sweet, granular, custardlike pulp. There is also a purplish coloured variety found in the West Indies.

It is passing strange that with so many varieties found in all tropical countries and probably suitable for domestication in most temperate climates that the useful mango is not more generally cultivated. The commonest species in India, where it is indigenous, is *Mangifera indica*, a large, quick-growing and wide-spreading tree whose panicles of scented, greenish-white flowers appear in January to March, the fruit in April to June thereafter. Some trees bear two crops a year. The ovoid fruit, flattened, with a distinct beak or projection at the apex, may weigh two pounds or more, but the usual weight is about 6 or 7 ounces. It has a tough, yellowish-red or greenish rind inclosing the adherent flesh, which has a peculiar but pleasant aromatic taste. Inferior fruit may be tough, with a turpentine flavour. The single seed or "stone," to which the slippery pulp adheres very closely, is quite large. These characteristics make it a somewhat difficult task, until one has learned the art, to consume a ripe mango in public and at the same time preserve good table manners.

Macmillan remarks:

The mango is the fruit par excellence of India, where it has been cultivated from time immemorial. Here it may be considered an article of food as well as dessert, whilst it also enters largely in the preparation of chutneys and preserves. The tree thrives from sea level to about 3,000 feet or higher. A hot and rather dry climate, and a rich, deep, well-drained soil, suit it best. The ground should be irrigated during prolonged drought, especially if the trees are setting fruit, also manured once a year, and mulched in dry weather. Pruning consists in thinning out superfluous or sickly branches; root pruning is sometimes applied with advantage to trees which become unfruitful, owing to their running too much into wood and leaf, the operation being performed by making a deep trench around the tree at a few feet from the stem and cutting clean all roots met with. Shade is not necessary, except when the plants are young. Propagation is best by grafting on seedling stocks of a hardy vigorous variety, or by in-arching or layering.

The largest, best-flavored, and most desirable varieties for general consumption that I have seen in north India come from Bengal, but the Indian mango has as many variants in size, flavor, color, and other qualities as the apple. It might well form a valuable and welcome addition to our supply of edible fruits.

There are many other tropical fruits awaiting domestication in more temperate climates which this short essay must ignore; I shall drop the subject with a brief mention of two species, both belonging to the luscious *Anonaceae*,

Number one, to be found in most tropical countries, I first tasted in British Guiana—the custard-apple, sometimes called bullock's heart (*Anona reticulata*). It is a small, bushy tree, found generally in low elevations, with a large brownish-red, round or heart-shaped fruit that contains several good-sized dark-brown seeds mixed with a sweet edible pulp. The latter resembles and taste much like an agreeable custard, although the Indian natives have a superstitious belief that continued indulgence in it causes leprosy.

Second, the cherimoyer (*Anona cherimolia*). This species is now quite common in India and the Far East, a small tree introduced from Peru. The fruit is large, oblong, cordate or round, from 3 to 5 inches in diameter, covered with small pits and weighing from 2 to 4 pounds. It stands transportation very well and seems especially fitted for cultivation in California, Florida and other semi-tropical States of the Union. Many authorities rank the cherimoyer with the pineapple and the mangosteen, and believe it to be far superior to its near relative, the *Anona reticulata*, which it most resembles. There are several cultivated races of this custard-apple, among them the quotemoyer and atemoyer, that differ from *A. cherimolia* chiefly in size and shape.

AGRICULTURAL PROGRESS IN NYASALAND*

Production and Export.—Increases in export occurred in 1932 in the cases of tobacco, tea, potatoes, cotton seed and rice. In the case of tea it can be recorded with satisfaction that, while the amount consigned to the United Kingdom showed an increase of over half a million pounds or nearly 27 per cent. the exports to South Africa, Southern and Northern Rhodesia have also increased. The market for Nyasaland tea was thus widened during 1932, and it included small but increased quantities for Germany and Portuguese East Africa.

Soil and Meteorological Investigations (by the Agricultural Chemist).—Soil and rainfall maps are desirable for the proper development of many areas, but the methods of analysis must aim firstly at a classification which can be of assistance to agriculturists and certain administrative officers. Naturally there is a large interest in tropical soil displayed by numerous scientific bodies and there is also the likelihood of co-operative work on climatic soil types which may occur not only in Nyasaland but also in similar climatic zones of Rhodesia, India and China.

It is also necessary to impress upon many of our agriculturists the extremely limited value of the results obtained by certain methods of analysis. There is still a strong belief that the estimation of the potash, phosphates and lime extracted by strong and dilute acids from a soil will indicate the need or otherwise of applications of certain fertilizers, even in areas where the distribution of important soil series and types is not known and on the soils of which no experiments of significance have been made, but this belief requires strong refutation.

The following notes will indicate the close relationship which surveys of climate and soil will have and silence the criticism that soil work should obtain results of immediate and great value to agriculturists in their crop and manurial problems without careful experimentation. Experiments must necessarily accompany work on soil series and types which cover large areas and their results should be of statistical significance. To clear up another matter which is often the subject of controversy, the following quotations are given to support the opinion of the writer. C. F. Marbut states, "The coincidence of soil belts and climate belts has caused soil students to conclude that climatic forces are the predominant soil-forming agencies of the world, obliterating or reducing to a subordinate position in relatively short time the influence of the parent rock material. In fact, in a study of the soils of a region, taking into consideration their broad

* Extracts from the last Annual Administration Report of the Director of Agriculture, Dr. W. Small.

general characteristics only, the influence of the parent material may be mainly neglected. This may be done with less and less risk of error as the climatic forces become more and more powerful." The Russian worker, Professor C. D. Glinka, says, "Is it, for instance, a matter of importance whether the soil is derived from granite, diorite or diabase? No, for researches in the field have shown that, under similar external conditions, all the above-mentioned rocks give uniform soils, while on the other hand we know that, under the influence of dissimilar external factors, soils differing profoundly from one another may be produced from the same type of granite."

Soil.—Studies of the distribution of acidity in soil profiles were continued and samples of typical profiles of important soil series were forwarded to the Imperial Institute for certain examinations of mineral constituents and analysis of the clay fraction.

Sulphur Deficiency (by the Mycologist).—Now that certain Nyasaland soils are known to be deficient in available sulphur, there is a scope for investigation into the effect of the deficiency on local crops other than tea. Preliminary experiments have been made. It is evident from these that more elaborate experiments may yield some interesting results. Only one experiment is recorded here as the result is of considerable importance to native cultivation on soils which are prone to sulphur deficiency and where fertilizing is unlikely to be employed. *Cowpea* (*vigna* sp.). Workers in other parts of the world, notably the United States of America, have found that a deficiency of sulphur in the soil may inhibit the formation of nodules on the roots of leguminous plants. The experiment to be described was carried out in the first place to see whether the same result would be obtained on soil growing tea badly diseased with yellows. If this was proved to be so, it would give evidence in favour of the conclusion since reached, namely, that yellows disease is caused by a deficiency of sulphur.

Randomised blocks were treated with nitrophoska and with nitrophoska plus sodium sulphate. Nitrophoska contains nitrogen, potash and phosphorus and only a trace of sulphur. A good stand of plants was obtained in the duplicated blocks and the following results were obtained:

(a) No yellow mottling of the leaves (cf. tea) was produced in the plots receiving no sulphate but the leaves were slightly lighter green and had a dull appearance compared to the dark shiny green leaves of the sulphate-treated plants.

(b) The sulphate-treated plants had leaflets of greater dimensions than those receiving no sulphate. There was a greater number of leaves per plant in the sulphate-treated plots. All records were taken before the seed pods were formed. As the flowers are produced from the axils of the leaves, a greater number of leaves per plant would indicate a bigger yield of seed per plant.

(c) The ratio of "tops" to roots was the same with both treatments.

(d) There was no difference in the mean size of nodules on the roots of plants receiving the two treatments.

(e) The number of nodules produced in the sulphate-treated plots was approximately ten times that produced in the no-sulphate plots.

The results show that *musa* bean plants grown on soil affected with tea yellows and not fertilized with sulphur produced very few nodules. The results indicate that the growing of leguminous green manures on some Nyasaland soils will not be beneficial to the soil unless the sulphur content is maintained, for the following reasons: (i) the amount of green material turned in will be small and (ii) the amount of nitrogen fixed by the plants will be small owing to the reduced number of nodules formed.

The native has methods of rotating his crops; he grows a considerable number of leguminous crops which should tend to keep up the nitrogen content of his soil. The deficiency of sulphur, however, which is likely to occur in his gardens will prevent beneficial results from being obtained by the use of leguminous crops. It is interesting to note that Dr. H. H. Mann in *The Tea Soils of North East India and their Treatment* states on page 74: "I have been informed that a dressing of the soil with sulphur has been found beneficial on these village sites in a few places, and this would favour the theory of infertility having a living origin such as the eelworm."

REVIEWS

ANNUAL REPORT FOR 1932 OF THE ROTHAMSTED EXPERIMENTAL STATION, 227 PAGES, PRICE 2/6D. OBTAINABLE FROM THE SECRETARY

TO the question, why continue agricultural research at a time when many farmers cannot sell profitably what they do produce? the answer is to be found in the words of Sir John Russell in this Report: "Scientific investigations in agriculture are primarily for the purpose of obtaining information, and this will always be needed so long as farming continues. It is in times of difficulty that expert information about soils, crops and animals is most valuable to farmers, for it enables them rapidly to alter their methods in accordance with the rapidly changing economic conditions." The work described in the Report shows the type of information that is being gained in order to deal with changes in modern conditions.

The Farm has developed greatly, in buildings, in ordinary farming operations, and in numbers of experimental plots. Further, equipment is now complete for examining the application of recent technical developments to agriculture. Electric light and a wide variety of electric motors are installed; also rubber floors and road paving, and pneumatic tyres on farm carts and tractors. The merits of these in practice are being critically examined.

Improvements in field experiments through the further application of statistical methods are recorded and illustrated by the results obtained with a number of crops. The value of these methods is that they both reduce the error of the results and make an estimate of the accuracy of the experiment possible. Some of the results—for example, those obtained with sugar-beet—illustrate the need for still more information in every-day farming problems. Why is it that no amount of manuring has overcome the difference in yield between beet crops in adjacent fields, where one field may produce twice as much root as the other? In connection with the manuring of sugar-beet, the value of ordinary agricultural salt has proved unexpectedly high, being no less than that of potash.

Experiments with other crops—potato, fodder mixtures, kale, grassland, wheat and rotations—are described. The inoculation of lucerne, and now of clover, is being closely studied in field and laboratory. The extent to which insect and fungus diseases have infested the two farms, at Rothamsted and at Woburn, is described in detail, and there is a most interesting summary of farm operations for the year in the Farm Director's Report.

Barley receives especial attention in the 1932 Report, in a summary of the striking results of ten years' investigations conducted in the laboratory and in the field all over England, under the Research Scheme of the Institute of Brewing. The practical applications of the results are clearly set out in reference to methods of cultivation, manuring, and the effects of weather and season.

In the laboratory section of the Report, the Soil Physics Department describes further progress in the comparison of rotary with other forms of cultivation, and in the interpretation of soil "tilth". The chemical properties of the soil are being studied by new methods, applied in particular to changes in soil organic matter as a result of different cropping or manurial treatments. The biological decomposition of organic matter is still under investigation, new information being obtained about the rotting down of straw—a surplus material that may be troublesome to deal with under mechanised farming. The purification of the effluent of sugar-beet factories by biological oxidation in filters has been carried satisfactorily to the semi-commercial scale; the effluent of milk factories is now being studied.

The work on plant diseases well illustrates the range of problems to be tackled. In a bacterial disease of cotton from the Sudan unusual stages in the life-cycle of the bacteria were found; the genetics of a fungus were studied over many years, and related to the behaviour of natural infections; in virus diseases—those caused by agents too small to be seen under the microscope—further progress is reported. The actual way in which the virus influences the plant and travels about its tissues, and the manner of its carriage by insects, are being elucidated. Insect pests receive special study, notably in relation to the enormous fluctuations in numbers that occur, and an attempt to relate these to weather changes is in progress. Automatic recording or trapping devices play a part both in this investigation and in a study of the work and the daily life of the hive bee. Methods of insect control by the use of vegetable products as insecticides continue to be studied. Pyrethrum, a very potent agent which can be grown in this country, offers problems both in cultivation and in the preservation of the toxic principle; those intriguing tropical plants that are used by natives as fish poisons are often valuable insecticides, but it is important to be able to measure their toxicity readily, and methods for doing this are being compared.

TWO PUBLICATIONS ON CACAO

(I) Second Annual Report on Cacao Research being conducted at the Imperial College of Tropical Agriculture, Trinidad. Price 5/- Government Printing Office, Port-of-Spain.

(II) Studies in West Indian Soils (VII).—The Cacao Soils of Trinidad; (A) Montserrat District by J. A. Mc Donalt, F. Hardy and G. Rodriguez. Price 2/- Government Printing Office, Port-of-Spain.

(I) The results of the second year's investigations into the *Cacao* plant indicate a considerable advance into the fundamental preliminaries of the problem. After a brief statement of the programme of botanical work by Professor Cheesman the subjects of vegetative propagation, genetic constitution of the crop and physiological factors influencing fruiting are considered by the investigators to whom these sections are deputed. These fundamental studies have not at present reached a stage such that practical direction for the increase of yield can be derived from them but they shew a gradual separation of the complexities of yield into components. The fact is well known to Ceylon cacao planters that the best bearing trees

from the point of pods are by no means invariably the largest yielders of beans. The opinion that trunk pods are more productive than branch pods is verified and no doubt in further studies this will be investigated from the point of desirability in a tree. The expression "good yielding trees" in the chapter on the "The Genetic Constitution of the Cacao Crop" might be clearly defined, for, even if we anticipate the next chapter, there is nothing lost by accentuating that ultimately good yield is to be measured by bean quality. For purposes of convenient reference the chapters of the book might be numbered. The typographical arrangement of the chapter headings involves undue necessity for back reference to see where we are in the programme of work. Shy setting of the flowers and their shrivelling are two very important factors contributing to low yield and the suggestion is that the supply of nitrogen in the nutrition at a critical stage plays a part at least so far as the setting is concerned. The work is generally characterised by fulness of treatment and if completed on the present lines will form a valuable contribution to our knowledge of cacao plants.

(II) The Studies in West Indian Soils discuss the composition and merits of a dozen cacao soil types. Yield variability, we are told, is smaller in young plantations but after some 40 years, soil and other factors mask the effect of youthfulness. Yields of plantations increase rapidly up to 20 years, then more slowly up to 25 years when a rapid decline sets in up to 40 years after which it is less so. The investigation should be studied in conjunction with the publication above by those interested in cacao plantations.

MEETINGS, CONFERENCES, ETC.

TEA RESEARCH INSTITUTE OF CEYLON

Minutes of the Meeting of the Board of the Tea Research Institute of Ceylon, held in the Victoria Commemoration Buildings, Kandy, on Saturday, the 2nd December, 1933 at 10.30 a.m.

Present.—Mr. R. G. Coombe (Chairman), the Hon'ble the Financial Secretary (Sir Wilfrid Woods, C.M.G.), Messrs. B. M. Selwyn, D. H. Kotalawala, M.S.C., John Horsfall, Jas. Forbes (Jnr.), I. L. Cameron, D. T. Richards, A. W. L. Turner (Secretary), R. R. Muras (Accountant), and by invitation Dr. Roland V. Norris (Director, T. R. I.), Mr. J. W. Ferguson (Visiting Agent), and Mr. Gordon Pyper.

Absent.—The Director of Agriculture, Messrs. C. E. Hawes, J. C. Kelly, and Col. T. G. Jayawardene, M.S.C.

1. Notice calling the Meeting was read.

The Late Governor Sir Graeme Thomson.—The Chairman said it was with feelings of sincere regret that he referred to the sad and sudden death of their late Governor, Sir Graeme Thomson.

By his untimely death the Empire had lost an able Administrator and this Colony a real and true friend in the truest sense.

He would ask them to signify their consent that the Tea Research Institute of Ceylon should join with the many who have already sent messages of sympathy to Lady Thomson in her great loss.

The vote of condolence was passed, all members standing.

2. (a) The Minutes of the Meeting of the Board of the Tea Research Institute of Ceylon, held on the 5th August, 1933, were confirmed.

(b) *Board Meeting.*—The Chairman apologised for having had to unavoidably postpone the Meeting from the 10th November, and hoped that members were not inconvenienced thereby.

(c) *Members of the Board of the T. R. I.*—The Chairman welcomed Mr. John Horsfall on his return from leave, and thanked Mr. Gordon Pyper for acting during that period. He also welcomed Dr. Norris, who had resumed duties as Director after 8½ months' leave.

3. JUNIOR STAFF PROVIDENT FUND

The Chairman asked for confirmation of the action of the Trustees of the Junior Staff Provident Fund in having deposited funds with the Ceylon Savings Bank.

The Board confirmed the action of the Trustees.

4. SENIOR SCIENTIFIC STAFF

(a) *Director, T. R. I.*—The Chairman announced that Dr. Norris, the Director of the Institute, resumed his duties as from the 25th October, 1933.

(b) *Mycologist—Dr. C. H. Gadd's Leave.*—The Chairman said that he had sanctioned Dr. Gadd's leave subject to confirmation of the Board. He would proceed on leave as from the 13th December, 1933, to the 22nd October, 1934. Ten months eight days in all. Six months 23 days on full pay and three months 16 days on half pay.

His agreement expires on the 30th June, 1934, and he hoped that all members would agree to its renewal. Dr. Gadd had been very seriously ill and he was sure that they would all congratulate him heartily on his return to health and express their appreciation for the work he had put in whilst acting as Director.

He would also like to thank Mr. Eden and Mr. Tubbs for the work they put in during Dr. Gadd's illness and the return of Dr. Norris.

It was agreed to grant Dr. Gadd's leave and to renew his Agreement for a further period of five years as from the 1st July, 1934.

(c) *Entomologist—Mr. C. B. R. King's Leave.*—This Officer's application for 8½ months' leave as from the 4th April, 1934, was considered and sanctioned.

(d) *Tea Technologist.*—The Chairman said that the Director had under instructions inserted an advertisement in "Nature".

He asked the Director to explain the position.

The Director reported that in accordance with the instructions given him by the Board he had advertised the appointment and also approached various Universities and Chemical Institutes. Twenty three applications had been received and from these a short list of five candidates prepared. Four of these candidates had been interviewed by a Selection Committee consisting of Mr. Stockdale, Mr. Horsfall and himself, while he had subsequently interviewed the fifth candidate alone.

As a result of these interviews the appointment of Mr. J. Lamb, M.Sc., was recommended. He was a Biochemist, Honours Graduate of London, with a year's training at Cambridge and a Government Scholarship in Trinidad, where he went for further training. He has been favourably reported on and had been selected by the Colonial Office for a Colonial appointment. He was 24 years old and the impression was that he was a very suitable type. He had not had any special mechanical training but there seemed no doubt that he would prove to be a suitable man.

Mr. John Horsfall supported all that the Director had said.

It was decided that immediately the State Council agreed to the maintenance of the 14 cents cess for 1934, a cable should be sent to Mr. Lamb offering him the appointment.

5. ST. COOMBS ESTATE

(a) *Broken Mixed Teas.*—The Chairman said that the Superintendent had written to say that this type of tea was accumulating in the factory and if not disposed of soon might result in a larger stock being stored in the factory than could be covered by the current insurance policy. He had consulted the Chairman of the Ceylon Estates Proprietary Association who recommended that the Superintendent should continue to sell as much of this type of Tea as possible to the labour force, at a price not below 22 cents. Whenever tea was sold to local caddies the receipt should be endorsed to the effect that the sale had been effected without coupons. Any Broken Mixed Teas not disposed of in this manner, he thought should be destroyed as it would not be wise for the Institute to sell at the door.

Messrs. Cameron, Richards and Ferguson all strongly deprecated the tea being sold locally except to the labour force.

Mr. Cameron suggested that as much of this grade be sold to the labour force at not less than 15 cents per lb. and the balance sold in Colombo as uncouponed tea.

This was agreed to by 4 votes to 3.

(b) *Tea Samples.*—The Chairman said that Mr. Cameron had suggested that although they could not agree to send samples of St. Coombs teas to individual estates or companies, samples of each invoice might be forwarded to the Ceylon Association in London, who would doubtless arrange for any persons interested at that end to see the teas. Mr. Richards said that he had mentioned in the Circular that a ¼-lb. packet would be quite sufficient and should be sent to any well-known London Tea Broker who would he felt be only too pleased to let the Institute have a report and retain the samples in his office.

The Meeting agreed to this latter suggestion.

(c) *Letter from the Agricultural Chemist re pruning Experiments.*—The Director said that the Experimental Sub-Committee had approved suggestions made by the Agricultural Chemist for the temporary use of one of the factory withering lofts for drying and weighing prunings obtained from the manurial plots. Information would in this way be obtained as to the influence of treatment on wood production, etc. The Insurance Company had intimated in writing that they had no objection to the proposals.

The Board confirmed the recommendation of the Experimental Sub-Committee.

(e) *Manuring Programme.*—The Board also adopted the Experimental Sub-Committee's recommendation that the present manuring programme be continued for a further period of one year.

6. CLOSER LIAISON BETWEEN BLENDERS, DISTRIBUTORS AND PRODUCERS OF TEA

The Chairman said that a copy of a letter written in this connection by Sir Theodore Chambers to Mr. G. K. Stewart was sent to each member of the Board on the 27th October.

It was decided to wait a further communication from the Ceylon Estates Proprietary Association before taking any action on the matter.

7. LEASE OF CADDY AT ST. COOMBS

On the Chairman's recommendation the Board agreed that the lease of the caddy which expires on the 14th January, 1934, should be renewed for a further period of three years, to the present tenant.

8. ADVERTISING THE "TEA QUARTERLY"

The Chairman said that since the last Meeting the Secretary had been in communication with the Indian Tea Association who supplied the names of 26 Agency Houses, out of which only three wished to be registered to receive the publications. The Secretary of the United Planters' Association of Southern India too was approached on this matter and he very kindly inserted a special paragraph in the "Planters' Chronicle" drawing attention to the Institute's Publications.

The Chairman added that he had requested the Secretary to order sufficient copies of the Annual Report from Tocklai issued by the Indian Tea Association for distribution amongst the members of the Board.

9. CHAIRMAN'S RESIGNATION

Mr. Coombe said that he would ask them to accept his resignation as Chairman of the Board.

He had asked Mr. Jas. Forbes (Jnr.) if he would take up the duties and he was glad to say that he had agreed to do so. It would, he suggested be more convenient for Mr. Forbes to relieve him after the Special Board Meeting being held on the 13th January, 1934, to consider the Estimates.

He would therefore ask the Board to agree to his proposal that Mr. Forbes take the Chair after the General Meeting to be held on the 13th January. They were he considered extremely fortunate in that Mr. Forbes had consented to take up the duties of their Chairman.

Mr. Forbes thanked the Chairman and said that if they so wished he was ready to take up the work and hoped that he would have the Board's full co-operation.

This was agreed to unanimously.

The Director said that he would like to be given an opportunity of expressing the regret of both the Senior and the Junior Scientific Staffs of the Institute that Mr. Coombe was vacating the Chairmanship and to express their deep appreciation of the very sympathetic consideration they had received from Mr. Coombe throughout his period of office.

The Meeting terminated with a vote of thanks to the Chair.

A. W. L. TURNER,
Secretary.

TEA RESEARCH INSTITUTE OF CEYLON

Minutes of the Meeting of the Board of the Tea Research Institute of Ceylon, held in the Ceylon Chamber of Commerce Rooms, Colombo, on Saturday, the 13th January, 1934, at 10.30 a.m.

Present.—Mr. R. G. Coombe (Chairman), the Director of Agriculture, Col. T. G. Jayewardene, V.D., M.S.C., Messrs. B. M. Selwyn, C. E. Hawes, D. H. Kotalawala, M.S.C., Jas. Forbes (Jnr.), I. L. Cameron, J. C. Kelly, F. A. Bond and A. W. L. Turner (Secretary) and by invitation Dr. Roland V. Norris (Director) and Mr. J. W. Ferguson (Visiting Agent).

Absent.—The Hon'ble the Financial Secretary and Mr. A. G. Baynham.

1. Notice calling the Meeting was read.

2. The Minutes of the Meeting of the Board of the Tea Research Institute of Ceylon, held on the 2nd December, 1933, and of the Finance Sub-Committee Meeting held on the 22nd December, 1933, were confirmed.

3. FINANCE

The Statement of Accounts as at 30th November, 1933, which had been sent to each member of the Board on the 21st December, 1933, was adopted.

4. MEMBERS OF THE BOARD OF THE INSTITUTE

(a) Announced that the Planters' Association of Ceylon had re-elected Mr. Jas. Forbes (Jnr.) for a further period of three years as from the 3rd December, 1933.

(b) Announced that Mr. John Horsfall had tendered his resignation and the Planters' Association of Ceylon had elected Mr. A. G. Baynham to serve in his place. The Chairman in proposing a very hearty vote of thanks to Mr. Horsfall for the very great amount of work he had done on behalf of the Institute mentioned the fact that Mr. Horsfall had been a member of the Deputation which visited Tocklai before the Institute was inaugurated and had been closely connected with the Institute ever since and had acted as Chairman of the Board for a period. This vote of appreciation was cordially agreed to.

(c) The Chairman welcomed Mr. F. A. Bond who had been nominated by the Ceylon Estates Proprietary Association to act during the absence of Mr. D. T. Richards who had proceeded on three months' leave as from the 20th December, 1933.

5. COMMITTEES

(a) *Experimental Sub-Committee.*—Mr. R. G. Coombe, previously an ex-officio member as Chairman, was renominated to the Sub-Committee on vacating the Chair, Mr. John Horsfall who had resigned from the Board was also renominated.

(b) *Finance Sub-Committee.*—Mr. A. G. Baynham was elected *vice* Mr. John Horsfall.

The following Sub-Committees were formed :—

(1) *Buildings Sub-Committee.*—The Chairman, T. R. I., the Director, and the Visiting Agent.

(2) *Medical Sub-Committee.*—The Chairman, T. R. I., the Director, T. R. I., and Mr. J. C. Kelly.

6. SENIOR SCIENTIFIC STAFF

Tea Technologist.—Announced that Mr. J. Lamb, the newly-appointed Tea Technologist, was sailing from Liverpool on the 19th instant and will therefore be due in Ceylon early in February.

7. JUNIOR STAFF T. R. I.

Mr. E. L. Keegal—Assistant to the Biochemist.—Announced that Mr. Keegal having been appointed to the Coconut Research Station had resigned his appointment with the Institute as from the 18th January, 1934.

Mr. J. W. Reith—Field Assistant.—Announced that Mr. Reith had been appointed Field Assistant, Grade II with effect from the 2nd January, 1934.

Mr. D. L. Nicol—Field Assistant.—Announced that Mr. Nicol having been appointed Superintendent of the Rubber Research Institute's Estate had resigned his appointment as from the 15th January, 1934, Mr. Reith had been appointed to take his place.

8. ST. COOMBS ESTATE

The Visiting Agent's Report.—The Report which was sent to each member of the Board under cover of Circular No. A. 1/34 of the 9th instant was adopted without any comments.

9. SMALL-HOLDINGS OFFICER'S REPORT

The Chairman said that a copy of this report had been sent to each member of the Board under cover of Circular No. A. 2/34 of the 9th instant. He said that it appeared to him from this Report that the Small-holders were looking after their estates and that Mr. Illankoon was doing very good work. He suggested that the Board should consider the appointment of an additional officer next year.

The Report was considered satisfactory.

10. ANY OTHER BUSINESS

The Director reported that he had received an offer from a Firm to supply free of cost for experimental purposes certain plant. Such a plant would enable further experiments to be carried out and he had informed the manufacturers that they would be glad to accept it.

The plant is to be returned when the experiments were concluded.

The Board confirmed the Director's action.

11. CHAIRMAN OF THE BOARD

Before vacating the Chair, Mr. R. G. Coombe expressed his thanks to the Board and to all Members of the Staffs at St. Coombs and Kandy for the assistance he had received during his term of office. He stated that now that the Board had agreed to erect the four Junior Staff Bungalows, that he had practically seen the building programme which he had originally suggested, completed.

Mr. Jas. Forbes (Jnr.) then took the Chair and thanked the Board for having elected him thereto.

Mr. Hawes proposed that a very sincere vote of thanks to Mr. R. G. Coombe should be recorded in the Minutes.

This was unanimously agreed to.

The Director expressed thanks to Mr. Coombe on behalf of the Scientific Staff.

Mr. Coombe having returned thanks, the Meeting terminated.

A. W. L. TURNER,
Secretary.

DEPARTMENTAL NOTES

ANIMAL HUSBANDRY IN CEYLON—PART II*

A SURVEY OF LIVESTOCK BREEDING IN CEYLON AT THE PRESENT TIME, WITH SUGGESTIONS FOR DEVELOPMENT

THERE is a tendency to consider that livestock plays a very small and unimportant part in the agricultural economy of Ceylon. It is therefore of value to endeavour to assess the annual income from livestock.

Livestock breeding is to a very large extent in the hands of the villagers and it is impossible to get anything like complete statistics.

The value of livestock in the country can be considered under the following heads:

(*a*) *For cultivation of fields and carting of produce.*—It is quite impossible to put a monetary value on this, but it is obvious that without cattle and buffaloes paddy cultivation would be impossible and the cultivation of every other crop including tea, rubber, and coconuts would be greatly handicapped. In spite of the great development of rail and motor transport, bullock transport still plays a very important part in all agricultural operations.

(*b*) *As a source of manure.*—Here again it is not possible to place a value. Cattle manure is but little used in paddy cultivation. In the coconut industry manuring by tying cattle round the palms is a general practice. It is little used on tea estates, although where it has been used, I believe, it is very satisfactory. It would appear to be a very suitable manure for soils which have lost their humus as a result of soil erosion. Goat manure is used to a fairly large extent in the Northern Province especially in tobacco cultivation.

(*c*) *Cash value of exports of animal products.*—Exports of animal products consist of hides and skins, tanned leather and meat. The value of these products as shown in the Customs returns are as follows:

	1929 Rs.	1930 Rs.	1931 Rs.
Hides and skins ...	1,096,770	923,745	517,451
Leather (tanned) ...	676,579	470,460	125,465
Meat ...	103,408	128,242	115,082
Total ...	1,876,757	1,522,447	757,998

* Appendix to Sessional Paper XXVII—December 1933 by M. Crawford, Government Veterinary Surgeon, Ceylon.

The falling off from 1929 to 1931 is due to the slump in prices but it will be seen that in 1929 the value of exports was close on two millions. A glance down the list of Ceylon exports will show that there are comparatively few exports, beyond the major crops, which exceed the figure. It is nearly equal to the value of plumbago exported and in 1929 exceeded such items as cardamoms, citronella oil, papain, timber, or tobacco. That is, animal products are one of the most important of Ceylon's minor exports.

(*d*) *Cash value of animal and animal products produced and consumed locally.*—It is possible to arrive at an approximate valuation of meat and mutton produced and consumed locally, but it is quite impossible to obtain any estimate of the value of such items as milk, ghee, curd, butter, table poultry, eggs, bacon, and leather.

The following estimates of value of cattle, buffaloes, sheep, and goats produced and consumed locally are of interest. Local animals slaughtered in the licensed slaughter-houses in 1932:

		Number	Estimated Value per Head Rs. c.	Total Value Rs.
Sheep and goats	...	42,798	5 00	213,990
Buffaloes	...	8,806	40 00	352,240
Neat cattle	...	81,224	20 00	1,624,480
			Total ...	2,190,710

That is, a sum of 2 million rupees most of which finds its way into pocket of villagers, a figure which makes the sale of cattle, etc., for meat one of the most important of the minor money-earning village industries.

The value of fresh milk produced and consumed locally probably exceeds this figure, while poultry and eggs must reach a very high total.

The above figures incomplete as they are suffice to show that the livestock industry is a more important source of income than is generally believed. It will be of value to consider the state of development of the livestock industry at present, taking each branch separately.

Cattle and Buffaloes may be considered under several sub-heads:—

(*a*) *Meat supply.*—The Island is largely self-supporting. Frozen, tinned and salted beef is imported, but the amount is not great and its use is largely confined to the wealthier classes. The total value of beef imported in 1931 was Rs. 148,779. The consumption of meat per head of population is low but is probably on the increase. The low level is accounted for by the fact that a large proportion of the population is Buddhist in religion. There would not appear to be much prospect of success in breeding cattle specially for the production of beef. The meat supply is largely obtained from the North-Western and the North-Central Provinces, especially from the Tamankaduwa area and to a smaller extent from the other Provinces,

Both neat cattle and buffaloes are slaughtered for food, but it is only in Colombo that any considerable number of buffaloes is slaughtered. For example, in 1931 out of a total of 10,431 buffaloes slaughtered in the whole Island, no less than 9,271 were slaughtered in Colombo town and Colombo District. The remainder of the Island depends almost entirely on neat cattle.

Facilities for selling cattle for slaughter are not good. One hears constant complaints in the villages that very poor prices are obtained from the itinerant cattle dealers. Attempts were made in 1929 and 1930 to start cattle fairs at Kurunegala, Polonnaruwa, and other places. They were a failure largely because of the trouble involved in bringing the cattle from the villages to the fairs and because dealers formed a ring to keep down prices.

The existence of rinderpest in recent years in the North-Central and the North-Western Provinces with the consequent restrictions on movement has interfered with the supply. The North-Western Province is now free of rinderpest and it is hoped that the North-Central Province will soon be in the same state.

(*b*) *Dairy supplies.*—The Island is very far from self-supporting and tinned milk to the value of over Rs. 1,000,000, butter to the value of about Rs. 500,000, ghee to the value of about Rs. 150,000, and cheese to the value of Rs. 105,000 were imported in 1931.

The warm climate, the perishable nature of milk and butter, and the lack of suitable methods of transport are difficulties which hinder development and which favour the use of tinned products. The high price of locally produced milk acts as a deterrent on the increased use of milk. It is difficult to see how the price can be reduced so long as we depend on dairies situated in or close to towns. Milk is cheaper in the up-country planting districts, in Tamankaduwa and a few other areas such as near Hambantota, but there are no facilities for transporting this cheaper milk to the towns.

The up-country planting districts are the chief source of supply of milking cows for the dairies in Colombo and other towns. These cows are descendants of cattle imported in the past by planters from Europe and Australia. They are bred chiefly by planters, kanganies, and Tamil labourers on the estates and are a most valuable asset to the country. Without them the town dairymen would have great difficulty in stocking their dairies.

In the past ten years very few cattle have been imported from Europe or Australia, high freight charges and the difficulty of disposing of surplus milk have deterred planters. Already evidence of deterioration can be seen in these cattle and fresh importations are needed if they are to maintain their present standard.

Given some means of transporting milk to Colombo and the other large towns, so that a remunerative outlet could be obtained for surplus milk, there appears to be every possibility that the number of such cattle kept on tea estates would be considerably increased. This would lead to a decrease in the importation of artificial manures.

In Colombo considerable quantities of buffalo milk are used and there are quite large dairies stocked with buffaloes. The buffaloes were formerly imported from India and were of a very high milk yielding breed. When importation of cattle from India was prohibited in 1930 the owners of these buffalo dairies found difficulty in maintaining their stocks and there was a tendency to replace the buffaloes by ordinary cows.

I understand that these dairymen have found that they can obtain buffalo cows of good milking capacity in the Tamankaduwa district. The Revenue Officer, Tamankaduwa, issues permits for the removal of such buffaloes by rail and he tells me that quite a regular trade has sprung up. The fact that buffaloes which give enough milk to make them suitable for the Colombo dairymen are to be found in Tamankaduwa is of the greatest interest and is an indication of the possibilities of this area.

Crossing of these good milking buffalo cows in the Tamankaduwa district with buffalo bulls of the high yielding Indian breeds should produce good results.

Ghee continues to be imported. In spite of this people who have made ghee locally experience great difficulty in disposing of it. Ghee is made in Tamankaduwa and other areas but the methods of manufacture are crude and wasteful and facilities for marketing it when prepared are practically non-existent.

The manufacture of butter is carried on to a very limited extent. Climate conditions are against it in most parts of the country but good butter can be made and is made to a small extent in the up-country districts.

(c) *Cattle for carting purposes.*—In most parts of the country the number of cart bulls available appears to be sufficient. The demand for the larger and heavier type of bull formerly imported from India has fallen very greatly with the increase in motor transport. These large heavy bulls were never popular with villagers for work on the smaller village roads. For such work bulls of the local type are preferred. A well-developed bull of the local breed by reason of his activity and gameness is very suitable for use on the village roads. In some parts of the country, as for example the Eastern Province, while cattle of the local breed are very numerous it is difficult to find among them sufficient animals well enough developed to make good cart bulls. This applies as a rule to all areas where paddy cultivation is extensive. In these areas the poor development of the cattle appears to be due to lack of sufficient food and the situation is often aggravated by over-stocking.

There would not appear to be any need to produce cattle of much larger size than the local breed for carting purposes, but there is need in most parts to provide sufficient food supply so that the cattle of the local breed may attain their best development. In many parts improvement would be produced could the numbers of useless cattle be reduced to a number more in keeping with the available food supplies. How this reduction is to be brought about is difficult to see. In Western countries useless animals would be disposed of to the butcher but the number which can be dealt with in this way in Ceylon is small, and religious prejudices

[illegible]. The same problem arises in East Africa but an attempt is being made to deal with it by the establishment of a meat-canning factory for the preparation of canned meat and meat extract for export. This method, however, is not likely to commend itself for use in Ceylon.

The estimates of the Northern Province had allowed for the Kangayam type imported from South India necessary for their work, and to meet their needs a Government Student at Kurrs is maintained with importation of cattle permitted, although it has been prohibited, of late.

The best for larger beasts in this area is probably due to the fact that very few buffaloes are found in the Jaffna District and ploughing is done by male cattle; other parts of Ceylon where ploughing or treading of lands is generally done by buffaloes.

The wetter buffaloes that should the practice of ploughing for and, or should buffaloes would not be so suitable when become common in other parts of Ceylon. Cattle will be used for larger work than the local breed.

As regards dairy cattle, nowhere, with the exception of Jaffna District the local breed satisfies the demand. The complaints of lack of numbers are heard but the animals are often smaller and weaker than they might be.

The number of dairy cattle imported for Jaffna District is not very great, about 500 per annum at present. The Jaffna cultivators will buy cattle from milk in this type but it should be possible to breed them in Tamankaduwa. If they could be bred in Tamankaduwa, it would be more with the advantage of keeping the Kangayam Student there with its advantages, notably, and not of importance in disease, a risk which will become much more important if the hopes of having the foot and mouth rinderpest within a few years are realized.

Sheep and goats.—In Ceylon they are only reared, as a rule. The [illegible] is made a good milk sheep by [illegible] and goats in which cases it is prized. Sheep and goat skins are exported. Comparatively few sheep are bred save in Jaffna and Batticaloa Districts. The bulk of the market demand is from goats. The Island is dependent on India for a considerable proportion of its supplies in sheep and goats.

There has been a very marked falling off in the total number of sheep and goats slaughtered in Ceylon since 1925 apparently due to the economic depression. The decrease has been almost in proportion to the imported animals. No great use has been made of importation. Duty value of total [illegible] imported only 25 per cent. of the total slaughtered, in 1926 they were 45 per cent. and this without any marked increase in slaughter of local animals. The figures are as considerable interest, they are, as follows:

Year	Total Number of Sheep and Goats Slaughtered in Licensed Slaughter-houses in Ceylon	Imported	Local	Percentage of Imported Sheep and Goats Slaughtered
1927	188,380	148,461	39,922	79
1925	163,300	124,276	39,024	24
1922	170,888	122,920	47,968	28
1920	147,775	90,471	57,304	38
1931	108,276	71,866	36,410	33
1932	93,842	51,044	42,798	45

Restrictions were imposed on the importation of sheep and goats in 1932 and a further decrease in the number imported may be expected in 1933. It is anticipated that the number of local animals slaughtered will show an increase in 1933.

The figures in the above table show only animals slaughtered in licensed slaughter-houses and do not include the large number of local animals slaughtered on private premises at the time of festivals etc.

It is in the drier parts of Ceylon that the largest numbers of sheep and goats are found. Neither sheep nor goats thrive in areas of heavy rainfall and no great increase in numbers can be anticipated in the wet zone.

In the Jaffna District goat manure is prized by tobacco cultivators who fold the animals on the fallow land at night time, the folds being moved from time to time until the whole area has been covered.

There does not appear to be any insuperable obstacle to prevent the total requirements of the Island being produced locally. It should be stressed, however, that goat breeding is essentially a side line. It is admirably suited for villagers in areas where grazing on scrub jungle is available.

Goat farming *per se* on a large scale is not likely to be a success and one would not be justified in advocating it. The restriction imposed on import has stimulated interest. This interest is being encouraged by the distribution of pamphlets and by demonstrations of castration by Veterinary officers.

The supply of good stud goats for breeding is not plentiful. Useful breeding animals are obtainable from time to time at the Colombo Quarantine Station and people interested have availed themselves of this source of supply.

Some of the larger landowners have flocks and it may be possible in the future to obtain breeding stock from these flocks. There is a small flock of goats at the Ambepussa Farm of the ordinary country breed which was started in 1931 with the object of obtaining knowledge of diseases and breeding problems. It is serving its purpose, but cannot be looked upon as yet as a source of good breeding stock. The climatic conditions at Ambepussa are not ideal and results up to the present have not been good. In the past month or two a considerable improvement is observable, which seems to have resulted from the use of a simple mineral mixture.

A corresponding flock kept under dry zone conditions should give valuable information.

A few goats of milking breeds are on order from England and it is proposed to try the effect of crossing these on the local type.

Marketing facilities are not good. The Colombo Municipal Council has recently provided a few enclosures at the Cattle Mart reserved for the purpose of exposing local goats for sale. Something more is needed. The most likely solution appears to be a Co-operative Society operating in the districts where sheep and goats are numerous and having its own mutton stall in Colombo which would be kept supplied by animals collected from the goat breeding areas. Such a stall could be hired in one of the Municipal markets.

It would advertise that only Ceylon mutton was sold. It would cut out the middleman's profit and should result in the breeders of the goats getting a better price. It would not be a costly experiment and, if a success, could be extended by taking further stalls in the other Municipal markets. Possibly the Municipal Council could be induced to let a stall to such a society on favourable terms.

The fact that the Colombo Cattle Mart and slaughter-house is not situated on the railway is very unfortunate and handicaps both cattle and goats. It means additional cost and trouble to take the animals from the railway stations to the Mart.

It would be a great convenience and would do much to popularize the use of locally bred animals if they could be unloaded straight from the trucks into the market. There would not appear to be much prospect of achieving this at present. The Colombo slaughter-house will however sooner or later have to be re-built and modernized, and when it is it should be on the railway or have a railway siding running into it.

Goat manure is of considerable value. It is used by cultivators in the Northern Province. Investigations might be made as to its value for different crops and the best methods of utilization.

Hides and skins.—There is a fairly considerable export trade in hides and skins which in a normal year approaches Rs. 1,000,000 in value. Very little information regarding this trade is available. Damage to hides from excessive branding is common. In some of the African Colonies steps have been taken to improve methods of skinning, preparation, and the grading of hides.

I have suggested to the Director of Commercial Intelligence that investigation of this trade might be carried out and if necessary the Imperial Institute, London, consulted regarding steps for improving the quality of grading the hides so that better prices might be obtained on the London market.

Poultry and eggs.—No figures are available to show the value of these. Both poultry and eggs are popular articles of diet and the annual consumption of these articles would reach a large figure.

Supplies of poultry, with the exception of small quantities of more or less luxury grades imported by cold storage companies, are all produced locally. Prior to 1930 live poultry were imported from India but importation was prohibited on account of the introduction of disease. Since then local supplies have proved ample to meet the demand. Prices have not risen and indeed show a tendency to fall. I have heard breeders complain lately that prices obtainable are too low to allow a margin of profit.

The figures for imports of these articles are of interest. They show that in 1929 live poultry to the value of Rs. 316,351 were imported and now none are imported. That is local supplies have proved able to supply the market without any increase in price, an illustration of what can be done when supplies are cut off.

Eggs still continue to be imported in large numbers. The numbers for 1931 show a decrease, but the value shows a much larger decrease probably due to the fall in prices of all foodstuffs. The figures taken from the Customs returns are as follows:

Eggs

Year		Number	Value Rs.	Value per Egg Cents (approx)
1928	...	10,698,136	345,182	3½
1929		15,143,881	502,301	3½
1930	...	14,898,681	879,806	6
1931	...	10,620,084	422,581	4
1932	...	9,444,862	314,374	3½

The number imported shows a tendency to decrease since 1929. A feature is the low value per egg each year except 1930. Values so low that it is difficult to see how they can be produced, collected, and shipped in Ceylon at a profit. It is difficult or impossible to produce eggs on poultry farms at a price which could compete. It may be possible for village producers to compete at these prices, provided they had an organization for putting their eggs on the market.

No doubt if importation were prohibited, as in the case of live poultry, the demand would be met from local sources without any marked increase in price. It is of course a question of policy whether such prohibition could be imposed or not. In the case of live poultry the reason for prohibition was to prevent introduction of disease, but no such reason could be advanced for prohibiting imports of eggs.

Pigs.—No accurate statistics are available to show either the number of pigs in the Island or the number slaughtered. The number in the Island is about 45,000. They occupy a comparatively unimportant place in Ceylon. They are only found in any considerable numbers in a few places, as for example along the sea-coast from Negombo to Kalutara, that is, an area where a fairly large Roman Catholic population is found. In this area the pigs are of the small country type and are utilized as fresh pork. Many appear to be slaughtered privately on Sundays and at festivals and holiday times. On some up-country estates pigs of English breeds are kept and appear to thrive well.

The only figures which I have been able to obtain are from the Colombo slaughter-house where the average number slaughtered is nearly 10 per day, that is about 3,500 per year in an average year.

There is a certain amount of prejudice against the use of locally reared pork on account of the way in which the animals are kept and their scavenging habits.

Bacon and ham is not prepared in Ceylon, all supplies being imported. Some years ago on an estate in Matale District pigs were bred in fairly large numbers as a source of manure for the estate. Bacon, which I am told, was of quite good quality was prepared on this estate on a small scale. The experiment failed, as the company concerned had not sufficient capital to build and equip a suitable plant for the regular production of

bacon on a large scale. The plant they had was small and of a makeshift nature. With it good bacon could be produced so long as they did not attempt to make more than a very small amount. When they attempted to increase production without increasing their equipment the quality of the bacon suffered greatly. I am also told that the manure produced gave excellent results on the estate which was planted in rubber and had suffered greatly from soil erosion. The imports of bacon, ham, and pork are as follows:

Imports of Bacon, Ham, and Pork

Year			Amount Cwt.	Value Rs.
1928	...	...	4,070	445,748
1929	...	...	4,226	465,671
1930	...	...	3,263	341,748
1931	...	...	3,575	290,245

The market appears to be limited. The Matale experiment appears to indicate that good bacon and pork could be produced in Ceylon but the plant is expensive as refrigerating machinery is required for the cooling and hanging room, etc. Captain J. E. Barnes, M.R.C.V.S., now of the Turf Club, was in charge of the work at Matale and would be in a position to give further information.

POSSIBILITIES OF DEVELOPMENT AND METHODS OF ASSISTING DEVELOPMENT

Beef cattle.—Beef consumption per head of population is very low and as the reason for this is religious there would not appear to be much possibility of any marked increase. As regards the small part of the population which have no objection on religious grounds to eating meat, e.g., the Christian and Muslim sections, increased consumption would probably result from improvement of the quality of the beef.

The type of cattle slaughtered is from the butchers' point of view definitely poor. After slaughter the usual practice, more or less necessitated by the warm climate, is for the meat to be eaten on the same day. There is no period of hanging to allow "ripening" to take place. Meat from the very highest quality butchers' cattle would be tough if used after this fashion. An adequate interval between killing and eating is regarded as of the greatest importance in such countries as England and America if the meat is to be at its best as regards tenderness, digestibility, and palatability.

Improvement in this respect could be brought about only by the provision of hanging rooms at the slaughter-houses which would require to be artificially cooled. Very low temperatures are not required and the development of cheap electrical power in the future may make such rooms a practical proposition. This is a matter which should be considered by the various local authorities in charge of slaughter-houses.

There would not appear to be much chance of success in regard to developing a type of cattle peculiarly suited for the butcher. The directions in which improvement are required are quicker maturity and better feeding.

Beef cattle in Ceylon at present and, as far as one can see, for a long time in the future are simple by-products of other cattle breeding activities, such as breeding of cart and dairy cattle.

The great majority of the surplus village cattle found in many parts of Ceylon would furnish only the poorest quality of beef even if a demand sufficient to absorb them existed. The only method of utilization that I can see is slaughter for hides, preparation of meat extract, glue, and fertilizer. A method which would require capital for the erection of suitable plant and is extremely unlikely to be adopted on account of religious prejudices.

It is a problem which is likely to become more acute as time goes on if our hopes of eradicating rinderpest in the near future are realized. Periodical epizootics of rinderpest have served to keep numbers down and the removal of such a potent natural check on the increase of numbers is bound to give rise to new problems. An example of the effects of rinderpest can be seen from the returns for numbers of cattle in the Eastern Province. This is a Province which has had long periods of freedom from rinderpest.

In 1908 the returns show a total of 153,531 cattle and buffaloes in the Eastern Province. In 1909 rinderpest gained entrance to this Province and spread very rapidly during 1909, 1910, and 1911. By 1911 the numbers had been reduced to 75,721, that is, less than half. The disease decreased after 1911, but was not finally eradicated until 1915. In 1915 the number of cattle had increased to 94,029, since then the Province has been free from rinderpest and, with minor fluctuations, the number has steadily increased until the return for 1932 showed a total of 210,198, the highest total recorded in the returns available in this office dating back to 1907. That is, since rinderpest was eradicated from this Province in 1915 the numbers of cattle and buffaloes have more than doubled themselves without any coincident increase in food supplies. It is hardly to be wondered at that the cattle to be seen to-day in the Eastern Province are among the poorest in the Island. In such a Province it would be of little value to distribute stud bulls of larger and better types.

Cart cattle.—A diminishing rather than an increasing demand for cart cattle is to be expected in the future. Numbers are generally sufficient, in some places excessive, but an improvement in size and strength is desirable. The chief factor limiting size and strength appears to be food supply rather than the nature of the breed available. A well-fed and developed bull of the local breed is a very efficient cart bull and very different from the ill-fed undersized specimens too commonly seen.

The only place where a real demand exists for bulls of a larger size than the local breed is in the Northern Province and it is of interest to note that is the only Province in the Island where the number of cattle shows a definite tendency to decrease. The Northern Province has been free from rinderpest from 1914 until 1932. In 1914 the number of cattle and buffaloes was 205,958, and in 1931 171,891. This is the only Province in the Island where any definite tendency towards a decrease in numbers can be observed.

In all other Provinces the numbers during the past 10 years show a tendency to increase. During a period of 10 years the total number of cattle and buffaloes in the Island has increased from 1,428,710 in 1922 to 1,678,684 in 1930, since when there has been a decrease to 1,615,920, largely accounted for by the epizootic of rinderpest in the North-Western, North-Central, and the Northern Provinces. The total in 1930 was the highest recorded since 1908, that is, the year when the last great epizootic of rinderpest started.

What is required, therefore, first of all is an increase in the food supply. This would automatically be brought about by a decrease in numbers. Failing such a decrease in numbers the only way appears to be to induce the cattle owners to take up a practice which is entirely foreign to their custom and ideas, that is, to grow fodder crops for the use of their cattle. Without this, to my mind, any attempts to improve cattle by introducing larger breeds are foredoomed to failure. This opinion is indeed borne out by the failure of attempts made from time to time during the past 30 years to put stud bulls in the villages for mating to village cows.

While this is true of the villagers examples are not wanting to prove that bigger and better cattle can be bred in Ceylon where steps are taken to feed and care for them, as can be seen on estates belonging to some of the larger landowners, especially in the North-Western Province.

Castration is sometimes advocated as a method of improving the breed. Efforts have been made for years past to popularize this and to train men to carry out the operation. The annual reports of the Veterinary Department show that very widespread demonstrations were given and a large number of men in the villages trained, for example, from 1905, 1908 demonstrations were given on 5,913 cattle, as a result of which 237 men were trained to carry out the operation and given certificates.

Demonstrations have been continued each year, of late years with the Burdizzo instrument in addition to the method of "tapping the cord" introduced by Mr. G. W. Sturgess. In spite of these efforts extending over 20 years castration has not become popular nor had any influence in improving the type of cattle.

A possible explanation of the failure of these attempts, both in respect of castration and in the case of stud bulls, is that efforts have been too scattered and made on too widespread a scale so that any effect produced quickly disappears. Probably more intensive efforts restricted to small selected areas and persistently followed up would have a greater chance of success. It is obvious that to attempt to improve the one-and-a-half million head of cattle and buffaloes in Ceylon by the distribution of stud bulls and castration of all other bulls unsuitable for breeding will require an enormous number of stud bulls and castrators. The limited funds available or likely to be available in the future would produce much better results if concentrated on fixed and definite areas, preferably such areas where natural conditions appear more favourable for the purpose.

Milk cattle.—As regards milk cattle the position is different. The diet of the great majority of people in Ceylon is largely composed of Cereals (rice) and vegetables. It has been shown definitely that milk forms a

valuable adjunct to any diet, but particularly to a diet restricted largely to cereals and vegetables. This is on account of the high physiological value of its fats, proteins, minerals, and vitamins. Large scale experiments have clearly shown the benefits which follow the addition of milk to the diet of school-going children. There is no doubt that marked benefit both in respect of better physique and increased resistance to disease would follow a greaty extended use of milk and other dairy products by the people of Ceylon.

There is thus a potential demand for increasing quantities of milk, even the existing demand is not being met by the local supply and is being supplemented by considerable importations of tinned milk.

The problem of the milk supply is not the same in all parts of Ceylon and may conveniently be dealt with as (*a*) milk supply in rural areas, (b) milk supply in towns.

In the rural areas most of the families own cattle but the cows are not milked as a rule, probably because they give so little that is not thought worth while.

The solution in this area would be along the lines of each family keeping a cow or two sufficient for their own needs. The type of cow required is not a very heavy milking cow, in most cases a cow giving 5 or 6 bottles per day would meet the needs of a family. A cow of delicate breed requiring skilled care and heavy feeding is not suitable.

While it is true that the average cow of the local breed does not give more than half to one bottle of milk per day, yet there are some specimens which give more. I have seen cows of the local breed which gave 7 bottles. The fact that such cows do occur in the native breed indicates that there are possibilities and that the proportion of good cows could be increased by selective breeding and additional care and attention in the calf stages.

The question of crossing the local cow with a better milking breed would require careful consideration. Crossing with cattle of European breeds should not be encouraged. The furthest one would feel any confidence in going in this direction would be crossing with the Sind breed. Even that would only be justified in cases where there was some guarantee that the food supply would be adequate to support the larger cattle which would result from the cross.

The most permanent result would be from selective breeding from among the local breed, a slow process requiring considerable patience, but which is probably the only method likely to produce a cow suitable for the conditions as found in the average Ceylon village.

As regards the milk supply of towns, at present this is almost entirely from dairies actually in the towns or very close to them. Comparatively little milk is brought to towns from distances over 5 miles and practically none from distances over 20 miles.

These town dairies do not breed their own cows, they are dependent largely on cows bred on up-country estates. A few, following the example of the Government Dairy, breed crosses between the Sind and European

breeds, the younger stock being reared on coconut estates in the low-country. The great majority prefer the up-country cows. These dairies fulfil a very useful function, the chief objection which can be raised to them is that they are expensive to run, and milk from them is bound to be high in price. They are also wasteful of cattle as very few indeed of the calves born in such dairies are reared to maturity.

They do not require any special encouragement. Their chief need is an ample supply of good milking cows at a reasonable price. These they have so far been able to obtain up-country, but as mentioned earlier the quality of the cows up-country show signs of falling off from lack of fresh blood.

Some of the town dairies are stocked with buffaloes. Formerly the buffaloes were obtained from India, but since 1930 they have had to depend on local sources and have had difficulty in obtaining buffalo cows giving enough milk to make them profitable. They are to some extent obtaining their requirements from Tamankaduwa. They would be helped by the provision of stud buffaloes of good milking strain for use in the Tamankaduwa area. No very great increase in the amount of milk produced by town dairies can be looked for and certainly no marked reduction in the price of milk. If increased consumption of milk in the towns is to brought about, then the present prices of milk will have to be greatly reduced. So far as I can see this can only be effected by the provision of cheap transport from areas where milk is more plentiful and cheaper. The areas where milk is fairly plentiful are the up-country tea planting districts and such areas as Tamankaduwa. If milk is to be brought from these areas the following would be required:-

(*a*) A distributing centre in the towns to receive and retail the milk.

(*b*) Safe transport by rail by means of refrigerating cars.

(*c*) Organization of the producers so that they could arrange to deliver this milk regularly at the railway station in a clean condition, preferably cooled down to 50 or 60°F as soon as drawn from the cows.

Preliminary steps would include experiments as to feasibility of transport and the length of time the milk would keep good. In connection with the examination of milk I have frequently brought samples of milk drawn in the afternoon at such places as Badulla and Nuwara Eliya to Colombo by night train and have found them quite sweet and fresh on arrival in Colombo next morning. This without any special method beyond cooling the sample after drawing, by immersing the bottle for half to one hour in cold water.

To bring milk from such places as Tamankaduwa, which are much warmer than up-country and where a supply of water cold enough to be used for milk cooling would not be available, would be more difficult and would probably mean that a collecting centre or centres would require to be established to treat the milk either by cooling or pasteurizing before putting on the railway.

Considerable difficulty would probably be met in educating the producers in clean methods of milking and handling the milk, both of which are very important if the milk is to have good keeping qualities. For these reasons the possibilities of obtaining milk from Tamankaduwa would appear to be more remote than from the up-country areas.

To my mind the Tanganyika and similar areas have distinct possibilities, but a beginning will have to be made on a very modest scale. A method which suggests itself is the establishment of a ghee making depôt. Nothing elaborate in the way of buildings or equipment would be required. A clean shed with a cream separator, a churn and pans for heating the butter or cream would be sufficient. The milk would be brought to such a centre by cattle owners in the vicinity and converted into ghee and sold. Payment would be made to the milk producers either at a fixed rate per gallon of milk or on the actual sum realised by the sale of the ghee. The advantage of such a scheme would be—

1. It would not be costly to start.
2. It would demonstrate what quantity of milk could be obtained in such areas.
3. It would demonstrate whether villagers could be induced to undertake the work of milking their cows and bringing the milk in a clean condition to the depôt, and what price would be needed to make it worth the villagers' while.
4. It would be a centre from which instructions regarding clean milking and handling would be disseminated, and if successful with ghee would lead on to the sending of fresh milk to the towns.

Such small ghee depôts in cattle rearing districts have been operated successfully in East Africa.

Sheep and goats.—There is room for a considerable increase in goat breeding. The scheme for restriction of imports has not yet had its full effect on account of the falling off in consumption of mutton caused by the financial situation. Any improvement in the financial situation will result in an increased demand for local sheep and goats, and if they are not available there will be agitation to increase the quota of imported animals.

So far as I can gather the barrier more than any other which is hindering the development of goat breeding is the difficulty breeders experience in getting a fair price for their animals or indeed of knowing where to find a purchaser. The chief market is in the towns but a connecting link between the breeder in the rural areas, often at a considerable distance from a town, and the town butcher is lacking. The town butchers are not interested in the local animals so long as they can get their requirements more conveniently from the importers of Indian and Aden animals.

Regular seasonal markets in the rural areas remedy the situation, but butchers will not patronise markets unless they are held regularly and the number of animals available is sufficient to make it worth the butchers' trouble attending them. So far attempts to establish markets have failed. A co-operative scheme as I have suggested earlier in this report would appear to be the best method.

Improvement of stock is also required, especially as regards the size. This can be brought about by avoiding breeding from immature females, early castration of males not required for stud, and the use of better stud goats.

Poultry.—Development of poultry breeding in the past few years has been fairly rapid and has now reached a stage where signs are not wanting that production is catching up with the demand and complaints are heard from breeders that prices obtained are poor. The chief difficulties appear to be the high cost of feeding because most of the foods used are imported, and the small size of eggs.

Investigation of the value of local foodstuffs is required and it is hoped to carry this out at Ambepussa Farm. If an efficient diet can be developed using the cheaper foodstuffs available locally it will be very useful.

Small egg size is a general failing and the underlying reasons are not well known. Recent experiments in America appear to show that as atmospheric temperature rises the size of eggs decreases. Should these experiments be proved correct we are up against a difficult problem. This is a matter which is already forcing itself upon our attention at Ambepussa Farm and which requires study.

The possibilities of poultry breeding in Ceylon are not yet known. Coconut estates seem to provide very favourable conditions and poultry breeding under coconuts appears to have a very beneficial effect on the palms. This has been particularly well demonstrated at Wester Seaton estate in Negombo. The two activities seem to go very well together and should the example of Wester Seaton estate be followed in any considerable scale the stage would soon be reached when an export market would have to be found.

Of all Ceylon's livestock products eggs would appear to be the only one save hides and skins which has prospects of developing an export trade. The English market is being supplied with eggs from places as far away as China and Australia. Recently India has entered this market. This stage is not reached yet but should a surplus become available the English market offers possibilities.

Pigs.—The prospects of development are poor. The market for fresh pork is limited and the supply is apparently sufficient to meet it. Whether Ceylon could produce its own bacon and ham is problematic. It is a business which would require considerable capital for plant. In the absence of a visible supply of pigs of a type suitable for bacon manufacture it would be difficult to raise capital for this purpose.

To sum up it may be said that Ceylon's livestock problems are bound up with the following basic factors:

(1) The small consumption of foodstuffs of animal origin consequent on the religious beliefs of a large proportion of the population. This results in a very restricted market with low prices.

(2) In many parts of the country over-stocking with cattle as a direct result of No. 1.

(3) Poor quality pasture due to lack of attention because the returns would not justify the expenditure of time and money, fencing and caring for them, and also due to over-stocking in many parts.

The solution is difficult. Without the urge of an adequate return it is difficult to stimulate interest.

ANIMAL DISEASE RETURN FOR THE MONTH ENDED 31 JANUARY, 1934

Province, &c.	Disease	No. of Cases up to Date since Jan. 1st 1933	Fresh Cases	Recoveries	Deaths	Balance Ill	No. Shot
Western	Rinderpest	...	...	...	...	...	...
	Foot-and-mouth disease	15	15	14	...	1	...
	Anthrax	...	...	...	...	...	...
	Rabies (Dogs)	4	4	...	...	...	4
	Piroplasmosis	...	...	...	...	...	...
Colombo Municipality	Rinderpest	...	...	...	...	...	...
	Foot-and-mouth disease	...	...	...	...	...	...
	Anthrax	...	...	...	...	...	...
	Rabies (Dogs)	1	1	...	...	...	1
	Haemorrhagic Septicaemia	...	...	...	...	...	...
	Black Quarter	...	...	...	...	...	...
	Bovine Tuberculosis	...	...	...	...	...	...
Cattle Quarantine Station	Rinderpest	...	...	...	...	...	...
	Foot-and-mouth disease (Sheep & Goats)	...	...	...	...	...	...
	Anthrax (Sheep & Goats)	1	1	...	1	...	...
Central	Rinderpest	FREE					
	Foot-and-mouth disease						
	Anthrax						
	Bovine Tuberculosis						
	Rabies (Dogs)						
Southern	Rinderpest	...	...	...	...	...	...
	Foot-and-mouth disease	65	65	59	...	6	...
	Anthrax	...	...	...	...	...	...
	Rabies (Dogs)	...	...	...	...	...	...
Northern	Rinderpest	27	27	3	24	...	...
	Foot-and-mouth disease	...	...	...	...	...	...
	Anthrax	...	...	...	...	...	...
	Black Quarter	...	...	...	...	...	...
	Rabies (Dogs)	...	...	...	...	...	...
Eastern	Rinderpest	...	...	...	...	...	...
	Foot-and-mouth disease	22	22	18	...	4	...
	Anthrax	...	...	...	...	...	...
North-Western	Rinderpest	FREE					
	Foot-and-mouth disease						
	Anthrax						
	Pleuro-Pneumonia (Goats)						
	Rabies (Dogs)						
North-Central	Rinderpest	FREE					
	Foot-and-mouth disease						
	Anthrax						
Uva	Rinderpest	FREE					
	Foot-and-mouth disease						
	Anthrax						
	Bovine Tuberculosis						
Saharagamuwa	Rinderpest	...	...	...	...	...	...
	Foot-and-mouth disease	...	...	...	...	...	...
	Anthrax	...	...	...	...	...	...
	Piroplasmosis	...	...	...	...	...	...
	Haemorrhagic Septicaemia	...	...	...	...	...	...
	Rabies (Dogs)	2	2	...	...	...	2

G. V. S. Office.
Colombo, 6th February, 1934.

MARTIN WIJAYANAYAKA,
for Government Veterinary Surgeon.

METEOROLOGICAL REPORT

JANUARY, 1934

Station	Temperature				Humidity		Amount of Cloud	Rainfall		
	Mean Maximum	Difference from Average	Mean Minimum	Difference from Average	Day	Night (from Minimum)		Amount	No. of Rainy Days	Difference from Average
	°	°	°	°	%	%		Inches		Inches
Colombo -	84·0	− 2·6	72·1	+ 0·1	75	88	7·0	12·22	17	+ 8·46
Puttalam -	83·7	− 1·6	70·9	+ 0·7	79	93	7·1	9·67	15	+ 6.90
Mannar -	81·9	− 2·1	74·2	0	81	90	7·7	11·95	16	+ 9·15
Jaffna -	82·0	− 0·8	72·9	+ 0·7	77	90	5·9	17·48	18	+ 14·57
Trincomalee -	80·7	+ 0·1	74·1	− 0·9	83	88	7·6	9·98	20	+ 3·16
Batticaloa -	80·3	− 1·3	73·4	− 0·3	84	93	7·4	12·10	23	+ 1·85
Hambantota -	83·2	− 1·9	72·4	− 0·4	78	90	5·7	5·84	17	+ 2·45
Galle -	83·2	− 1·2	72·9	+ 0·1	82	93	6·4	6·56	16	+ 2·39
Ratnapura -	86·7	− 2·6	71·4	+ 0·3	79	98	7·2	12·64	22	+ 7·12
A'pura -	81·2	− 1·0	70·9	+ 1·3	85	97	8·9	13·48	20	+ 9·51
Kurunegala -	84·4	− 1·6	70·0	− 0·4	76	95	8·0	12·63	19	+ 8·85
Kandy -	80·3	− 2·2	67·7	+ 0·5	74	90	6·8	7·66	20	+ 2·36
Badulla -	74·4	− 1·9	64·2	+ 0·4	86	97	8·0	16·17	26	+ 6·69
Diyatalawa -	69·9	− 2·0	59·1	+ 1·5	84	94	8·3	16·67	24	+ 10·78
Hakgala -	65·3	+ 2·1	53·1	− 2·2	87	94	8·0	22·85	26	+ 12·74
N'Eliya -	65·5	− 1·7	50·6	− 4·1	80	93	7·8	11·00	21	+ 5·25

The rainfall of January was above normal over almost the whole of Ceylon, the only appreciable area showing deficit comprising the districts to the south and south-west of Batticaloa, while a few isolated stations, mainly in or near the hills, also recorded deficits.

The greatest excesses above average were somewhat irregularly distributed, occurring most consistently in the north of Ceylon, in the south and south-east of the hill-country, and along the west coast, from Colombo southwards. The rainfall distribution was less definitely orographical than usual, the comparatively heavy rainfall in the nor.h of the Island suggesting incipient depressional activity.

The greatest monthly totals were 45·35 inches at Hendon, and 43·11 at St. Martin's while Udahena was over 24 inches above its average, and Lunugala, Meeriabedde, and Koslanda showed excesses of 16 to 17 inches.

There were 44 daily falls of 5 inches or more reported during the month, more than half of them for the rainfall day, 25-26th. The highest fall reported was 9·17 inches, at Ella, on the 25-26th.

The dry spell which had persisted over Ceylon during the latter part of December terminated just before the end of that month, and the New Year commenced with wide-spread rains over the Island. The weather remained unsettled over the greater part of January, and on several occasions it seemed likely that a depression was about to form. It was not until about the 23rd however, that a definite depression formed, to the east of Ceylon. Instead of taking the usual north-westerly course, this moved in a westerly direction, and its centre apparently passed over the south of the Island between the 24th and the 25th. It was not accompanied by unusually heavy winds, but after it had passed, and probably as a result of the south-easterly winds in its rear meeting the obstacle formed by the hill-country of Ceylon, there was heavy rain, between the 25th and the 26th, over a large part of the south of the Island. This was particularly heavy in the districts on or near the south-eastern slopes of the hills, where falls, for the 24 hours, up to 9 inches were recorded. As the depression moved away the weather improved, and from the 27th till the end of the mouth there were generally clear skies, with but little rain.

Day temperatures were generally below normal, and night temperatures about normal. Humidity and cloud were both above normal. Barometric pressure was below average, and the mean gradient north-westerly rather than northerly. The wind was generally north-easterly and on the whole about normal strength.

H. JAMESON,
Supdt., Observatory.